

**PENERAPAN MODEL PEMBELAJARAN BERORIENTASI  
PEMECAHAN MASALAH DILEMATIS SECARA  
KOLABORATIF UNTUK MENINGKATKAN KEMAMPUAN  
KOGNITIF, KETERAMPILAN BERPIKIR KRITIS DAN  
KEMAMPUAN PENGAMBILAN KEPUTUSAN SISWA SMA**

**TESIS**

**Diajukan untuk Memenuhi Sebagian dari  
Syarat untuk Memperoleh Gelar Magister Pendidikan  
Program Studi Pendidikan Fisika**



**Oleh**

**ASEP KURNIAWAN  
1605144**

**PROGRAM STUDI PENDIDIKAN FISIKA  
SEKOLAH PASCASARJANA  
UNIVERSITAS PENDIDIKAN INDONESIA  
2019**

---

---

PENERAPAN MODEL PEMBELAJARAN BERORIENTASI PEMECAHAN  
MASALAH DILEMATIS SECARA KOLABORATIF UNTUK  
MENINGKATKAN KEMAMPUAN KOGNITIF, KETERAMPILAN  
BERPIKIR KRITIS DAN KEMAMPUAN PENGAMBILAN KEPUTUSAN  
SISWA SMA

Oleh  
Asep Kurniawan

Sebuah Tesis yang diajukan untuk memenuhi salah satu syarat memperoleh  
Magister Pendidikan (M.Pd.) pada Program Studi Pendidikan Fisika

© Asep Kurniawan 2019  
Universitas Pendidikan Indonesia  
Agustus 2019

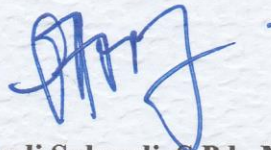
Hak Cipta dilindungi Undang-undang.  
Tesis ini tidak boleh diperbanyak seluruhnya atau sebagian, dengan dicetak ulang,  
difotocopy, atau cara lainnya tanpa izin dari Penulis.

**ASEP KURNIAWAN**

**PENERAPAN MODEL PEMBELAJARAN BERORIENTASI  
PEMECAHAN MASALAH DILEMATIS SECARA  
KOLABORATIF UNTUK MENINGKATKAN KEMAMPUAN  
KOGNITIF, KETERAMPILAN BERPIKIR KRITIS DAN  
KEMAMPUAN PENGAMBILAN KEPUTUSAN SISWA SMA**

Disetujui dan disahkan oleh pembimbing:

Pembimbing I



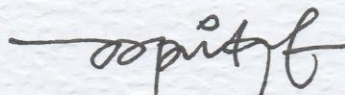
**Prof. Dr. Andi Suhandi, S.Pd., M.Si.**  
NIP. 196908171994031003

Pembimbing II



**Dr. Ida Kaniawati, M.Si**  
NIP. 196807031992032001

Mengetahui,  
Ketua Program Studi Pendidikan Fisika



**Dr. Taufik Ramlan Ramalis, M.Si**  
NIP. 195904011986011001

# **Penerapan Model Pembelajaran Berorientasi Pemecahan Masalah Dilematis Secara Kolaboratif Untuk Meningkatkan Kemampuan Kognitif, Keterampilan Berpikir Kritis Dan Kemampuan Pengambilan Keputusan Siswa SMA**

Asep Kurniawan, 1605144

## **Abstrak**

Penelitian ini bertujuan untuk memperoleh gambaran tentang peningkatan kemampuan kognitif, keterampilan berpikir kritis, dan kemampuan pengambilan keputusan siswa SMA sebagai efek dari penerapan model pembelajaran berorientasi pemecahan masalah dilematis secara kolaboratif dalam pembelajaran fisika. Metode penelitian yang digunakan adalah pre-eksperimen dengan desain satu kelompok *pretest-posttest*. Subjek penelitian adalah 36 siswa salah satu SMA di Kabupaten Bandung Barat. Subjek dipilih dengan teknik acak kelas. Instrumen penelitian yang digunakan meliputi tes kemampuan kognitif berbentuk pilihan ganda, tes keterampilan berpikir kritis berbentuk uraian, tes kemampuan pengambilan keputusan berbentuk pilihan dengan alasan, dan lembar observasi kegiatan siswa. Peningkatan kemampuan kognitif, keterampilan berpikir kritis dan kemampuan pengambilan keputusan siswa SMA dianalisis menggunakan skor *gain* rata-rata yang ternormalisasi,  $\langle g \rangle$  dirumuskan oleh Hake. Hasil menunjukkan kemampuan kognitif secara keseluruhan adanya peningkatan dengan skor rata-rata  $\langle g \rangle$  sebesar 0,64 dengan kategori sedang. Pada keterampilan berpikir kritis terdapat peningkatan keterampilan dengan skor rata-rata  $\langle g \rangle$  sebesar 0,51 dengan kategori sedang dan peningkatan kemampuan pengambilan keputusan ditunjukkan dengan skor rata-rata  $\langle g \rangle$  sebesar 0,65 dengan kategori sedang. Hal tersebut menunjukkan bahwa model pembelajaran berorientasi pemecahan masalah dilematis dapat meningkatkan kemampuan kognitif, keterampilan berpikir kritis, dan kemampuan pemecahan masalah siswa SMA yang ditunjukkan dengan peningkatan rata-rata *N-gain* pada kategori sedang.

**Kata Kunci:** *model pembelajaran berorientasi pemecahan masalah dilematis, kolaboratif, kemampuan kognitif, keterampilan berpikir kritis, kemampuan pengambilan keputusan*

# **Application of Dilemmatic Problem-Solving Oriented Learning with Collaborative Model in Physics Teaching on Improvement Cognitive Ability, Critical Thinking Skills and Decision-Making Skills Senior High School Students**

Asep Kurniawan, 1605144

## **Abstract**

This aim of study is to obtain an overview of the improvement cognitive ability, critical thinking skills and decision-making skills of senior high school students as the effect of applying dilemmatic problem-solving oriented learning with collaborative model in physics teaching. The research method used is pre-experiment with one group pretest-posttest design. The subjects of the study were 36 students in one of the high schools in West Bandung district. Instruments used for decision-making skill data collection at before and after learning is a test of cognitive ability in the form multiple choice test, a test of critical thinking skills in the form of essay test and a test of decision-making skills in the form of choice and reason. The improvement of cognitive ability, critical thinking skills and decision-making skills of high school students was analyzed using the concept of normalized average gain scores,  $\langle g \rangle$  formulated by Hake. The results showed that overall cognitive abilities were increased with an average score of  $\langle g \rangle$  of 0.64 with the moderate category. In critical thinking skills there is an increase in skills with an average score of  $\langle g \rangle$  by 0.51 in the medium category and an increase in decision making ability is indicated by an average score  $\langle g \rangle$  of 0.65 with a moderate category. This shows that the use of dilemmatic problem solving-oriented learning model in Physics learning has a moderate effectiveness in facilitating the improvement of decision-making skill of high school students

**Keyword:** *dilemmatic problem-solving, collaborative, cognitive ability, critical thinking skills, decision making skills*

## DAFTAR ISI

	Halaman
<b>HALAMAN JUDUL</b> .....	i
<b>HALAMAN PENGESAHAN</b> .....	ii
<b>PERNYATAAN</b> .....	iii
<b>ABSTRAK</b> .....	iv
<b>KATA PENGANTAR</b> .....	vi
<b>LEMBAR HAK CIPTA</b> .....	vii
<b>UCAPAN TERIMA KASIH</b> .....	viii
<b>DAFTAR ISI</b> .....	x
<b>DAFTAR TABEL</b> .....	xii
<b>DAFTAR GAMBAR</b> .....	xiii
<b>DAFTAR LAMPIRAN</b> .....	xiii
 <b>BAB I</b>	
<b>PENDAHULUAN</b> .....	1
1.1. Latar Belakang Masalah .....	1
1.2. Rumusan Masalah .....	10
1.3. Tujuan Penelitian .....	10
1.4. Manfaat Penelitian .....	11
1.5. Definisi Operasional .....	11
1.6. Struktur Organisasi Penelitian .....	13
 <b>BAB II</b>	
<b>KAJIAN PUSTAKA</b> .....	14
2.1. Pengambilan Keputusan .....	14
2.2. Hubungan Antara Pemecahan Masalah dan Pengambilan Keputusan ..	20
2.3. <i>Dilemmatic Problem</i> .....	21
2.4. Keterampilan Berpikir Kritis .....	23
2.5. Pentingnya Kemampuan Kognitif dalam Pengambilan Keputusan .....	26
2.6. Pembekalan Keterampilan Pengambilan Keputusan melalui Pembelajaran Berorientasi Pemecahan Masalah secara Kolaboratif .....	29
2.7. Kerangka Pikir Penelitian .....	35
2.8. Uraian Materi Teori Kinetik Gas .....	36
 <b>BAB III</b>	
<b>METODOLOGI PENELITIAN</b> .....	41
3.1. Metode dan Desain Penelitian .....	41
3.2. Populasi dan Sampel Penelitian .....	41
3.3. Variabel Penelitian .....	42
3.4. Langkah-langkah Penelitian .....	42
3.5. Instrumen Penelitian .....	44
3.6. Alur Penelitian .....	48
3.7. Analisis Instrumen .....	49
3.8. Pengolahan data .....	51

<b>BAB IV HASIL DAN PEMBAHASAN</b> .....	54
4.1. Peningkatan Kemampuan Kognitif .....	54
4.2. Peningkatan Keterampilan Berpikir Kritis .....	62
4.3. Peningkatan Kemampuan Pengambilan Keputusan .....	69
<b>BAB V</b>	
<b>KESIMPULAN DAN SARAN</b> .....	77
5.1. Kesimpulan .....	77
5.2. Implikasi .....	77
5.3. Rekomendasi .....	78
<b>DAFTAR PUSTAKA</b> .....	79
<b>LAMPIRAN-LAMPIRAN</b> .....	89

## DAFTAR TABEL

	Halaman
Tabel 2.1. Deskripsi Berpikir Kritis domain spesifik dan domain umum .....	24
Tabel 2.2. Taksonomi Bloom yang telah Direvisi Anderson dan Krathwohl.	27
Tabel 2.3. Matriks Hubungan antara Model Pembelajaran Berorientasi Pemecahan masalah Dilematis secara Kolboratif dengan Kemampuan Kognitif, Keterampilan Berpikir Kritis dan Kemampuan Pengambilan Keputusan .....	33
Tabel 3.1. Rubrik Pengisian Lembar Observasi Keterlaksanaan Pembelajaran yang Menerapkan Model Pembelajaran Berorientasi Pemecahan Masalah Dilematis secara Kolaboratif oleh Siswa.....	45
Tabel 3.2. Interpretasi Reliabilitas .....	50
Tabel 3.3. Rekapitulas hasil Uji Reliabilitas Tes Kemampuan Kognitif, Keterampilan Berpikir Kritis dan Kemampuan Pengambilan Keputusan.....	51
Tabel 3.4. Pedoman Penskoran Soal Pilihan Ganda .....	51
Tabel 3.5. Rubrik Penilaian Keterampilan Berpikir Kritis .....	52
Tabel 3.6. Rubrik Penilaian Kemampuan Pengambilan Keputusan .....	52
Tabel 3.7. Kategori Rata-rata Gain Ternormalisasi .....	53
Tabel 4.1. Matriks Hubungan antara Tahapan Model Pembelajaran Berorientasi Pemecahan Masalah Dilematis secara Kolaboratif dengan Kompetensi yang Diharapkan .....	55
Tabel 4.2. Sebaran Kategori N-gain Kemampuan Kognitif secara keseluruhan .....	57
Tabel 4.3. Rekapitulasi Rata-rata N-gain Kemampuan Kognitif Siswa pada setiap Aspek Kognitif .....	58
Tabel 4.4. Matriks Hubungan antara Tahapan Model Pembelajaran Berorientasi Pemecahan Masalah Dilematis secara Kolaboratif dengan Aspek Keterampilan Berpikir Kritis .....	62
Tabel 4.5. Rekapitulasi Rata-rata Hasil Pretest, Posttest, dan N-gain Keterampilan Berpikir Kritis Siswa Secara Keseluruhan .....	64
Tabel 4.6 Rata-rata skor Pretest dan Posttest setiap Aspek Keterampilan Berpikir Kritis .....	65
Tabel 4.7 Rata-rata N-gain Tiap Aspek Keterampilan Berpikir Kritis .....	66
Tabel 4.8 Matriks Hubungan antara Tahapan Model Pembelajaran dengan Aspek Kemampuan Pengambilan Keputusan .....	70
Tabel 4.9 Rekapitulasi Rata-rata Hasil Pretest, Posttest, dan N-gain Kemampuan Pengambilan Keputusan Secara Keseluruhan .....	72
Tabel 4.10 Rata-rata N-Gain Tiap Aspek Kemampuan Pengambilan Keputusan .....	72
Tabel 4.11 Prosentase Keterlaksanaan Model Pembelajaran Berorientasi Pemecahan Masalah Dilematis Secara Kolaboratif oleh Guru dan Siswa .....	74



## DAFTAR GAMBAR

	Halaman
Gambar 2.1. Bagan Kerangka Pikir Penelitian .....	36
Gambar 2.2. Gas Properties pada suhu tetap .....	36
Gambar 2.3. Grafik Hubungan Volume dan Tekanan pada Suhu Tetap .....	37
Gambar 2.4. Gas Properties pada Tekanan Tetap .....	37
Gambar 2.5. Grafik Hubungan Volume dan Temperatur pada Tekanan Tetap	39
Gambar 2.6. Gas Properties pada volume Tetap .....	40
Gambar 3.1 Bagan Desain Penelitian <i>One Group Pretest-Posttest</i> .....	41
Gambar 3.2. Alur Penelitian.....	41
Gambar 4.1. Diagram Hasil <i>Pretest</i> dan <i>Posttest</i> Kemampuan Kognitif Secara Keseluruhan.....	56
Gambar 4.2. Diagram Peningkatan Kemampuan Kognitif Siswa Pada Dimensi Proses Kognitif C1, C2, dan C3 .....	58
Gambar 4.3. Contoh Soal Tes Kemampuan Kognitif pada Dimensi Proses Kognitif C1.....	59
Gambar 4.4. Aktivitas Siswa dalam Tahapan Kegiatan Penanaman Konsep Secara Interaktif .....	60
Gambar 4.5 Contoh Soal Tes Kemampuan Kognitif pada Dimensi Proses Kognitif C2 dan C3 .....	60
Gambar 4.6 Diagram Distribusi <i>N-gain</i> Peningkatan Keterampilan Berpikir Kritis Secara Keseluruhan.....	64
Gambar 4.7 Aktivitas Siswa pada Tahap Pengujian Hipotesis .....	67
Gambar 4.8 Cuplikan Hasil Kegiatan Siswa .....	67
Gambar 4.9 Contoh Jawaban Siswa Pada Tes Kemampuan Pengambilan Keputusan Pada Aspek Memutuskan Pilihan .....	75

## DAFTAR LAMPIRAN

	Halaman
Lampiran – Lampiran .....	89
Lampiran A Perangkat Pembelajaran.....	90
Lampiran A.1 Silabus.....	91
Lampiran A.2 Rencana Pelaksanaan Pembelajaran .....	94
Lampiran A.3 Lembar Kerja Siswa .....	106
Lampiran B Instrumen Penelitian .....	129
Lampiran B.1 Rancangan Instrumen Penelitian.....	130
Lampiran B.2 Instrumen Kemampuan Kognitif .....	131
Lampiran B.3 Instrumen Keterampilan Berpikir Kritis .....	137
Lampiran B.4 Instrumen Kemampuan Pengambilan Keputusan .....	153
Lampiran B.5 Lembar Judgment Instrumen Tes Kemampuan Kognitif dan Kemampuan Pengambilan Keputusan.....	160
Lampiran B.6 Lembar Observasi Keterlaksanaan Model .....	202
Lampiran C Analisa Data.....	206
Lampiran D Dokumen Penelitian.....	230

## DAFTAR PUSTAKA

- Acar, O., Turkmen, L., & Roychoudhury, A. (2009). Student Difficulties in Socio-scientific Argumentation and Decision-making Research Findings: Crossing the borders of two research lines. *International Journal of Science Education*, 32(9), 1191–1206.
- Adesoji, F. A. (2008). Students' Ability Levels and Effectiveness of Problem-Solving Instructional Strategy. *J. Soc. Sci.*, 17(1), 5-8.
- Akinoglu, O. & Tandongan, R.O. 2007. The Effects of Problem-Based Active Learning Inscience Education on Students' Academic Achievement. *Eurasia Journal of Mathematics, Science & Technology Education*, 3(1), 71-81.
- Alshamali, M. A. & Daher, W. M. (2015). Scientific Reasoning and Its Relationship with Problem Solving: The Case of Upper Primary Science Teachers. *Int J of Sci and Math Educ*, 14(6).
- Anderson, L W, & Krathwohl D R (eds.). (2009). *A Taxonomy for Learning, Teaching, and Assesing: A Revision of Bloom's Taaxonomy of Educational Objectives*. New York: Longman.
- Arya, D. & Maul, A. (2004). The Building of Knowledge, Language, and Decision-Making about Climate Change Science: A Cross-National Program for Secondary Students. *International Journal of Science Education*. 38(6), 885-904
- Arvai, J. L., Campbell, V. E. A., Baird, A., & Rivers, L. (2004). Teaching Students to Make Better Decisio About the Environment: Lessons from the Decision Sciences. *The Journal of Environmental Education*, 36(1), 33–44.
- Asha, I. K. & Hawi, A. M. A. (2016). The Impact of Cooperative Learning on Developing the Sixth Grade Students Decision-Making Skill and Academic Achievement. *Journal of Education and Practice*, 7(10).
- Asmorowati, D. S. (2009). Pembelajaran Kimia menggunakan kolaborasi konstruktif dan inkuiri berorientasi Chemo-Entrepreneurship. *Jurnal Inovasi Pendidikan Kimia*, 3(2).
- Awang, Halizah & Ramly, Ishak. 2008. Creative Thinking Skill Approach Through Problem-Based Learning: Pedagogy and Praticce In tne Engineering Classroom. *International Journal of Human and Social Science*, 3(1).

- Baharun, H. (2015). Penerapan Pembelajaran Active Learning untuk Meningkatkan Hasil Belajar Siswa di Madrasah. *PEDAGOGIK: Jurnal Pendidikan*, 1(1).
- Balta, N & Awedh, M. H. (2017). The Effect of Student Collaboration in Solving Physics Problems Using an Online Interactive Response System. *European Journal of Educational Research*, 6, 385 – 394.
- Barkley, Elizabeth E., Cross, K. Patricia & Major, Clair Howell. (2012). *Collaborative Learning Techniques: Teknik-teknik Pembelajaran Kolaboratif*. Penerjemah: Narulita Yusron. Bandung: Penerbit Nusa Media.
- Barrows, H. S. (1996). Problem based learning in medicine beyond: A brief overview. *New Direction for Teaching and Learning*, (68), 3-12.
- Basyaib, Fachmi. (2006). *Teori Pembuatan Keputusan*. Jakarta: Grasindo.
- Baumberger-Henry, M. (2005). Cooperative learning and case study: Does the combination improve students' perception of problem-solving and decision making skills? *Nurse education today*, 25(3), 238-246.
- Bernholt, S., Eggert, S., & Kulgemeyer, C. (2012). *Capturing the diversity of students' competences in science classrooms. Differences and commonalities of three complementary approaches*, in Making It Tangible—Learning Outcomes in Science Education, S. Bernholt, K. Neumann, & P. Nentwig, Eds., 187–217, Waxmann, Münster, Germany.
- Bilgin, I., Senocak, E., & Sozbilir, M. 2009. The Effects of Problem –Based-Learning Instruction on University Students' Performance of Conceptual and Quantitative Problems in Gas Concepts. *Eurasia Journal Mathematics, Science & Technology Education*, 5(2), 153-164.
- Böttcher, F & Meisert, A. (2012). Effects of Direct and Indirect Instruction on Fostering Decision-Making Competence in Socioscientific Issues *Res Sci Educ*, 43, 479–506.
- Bowe, B., Flynn, C., Howard, R., & Daly, S. 2003. Teaching Physics to Engineering Students Using Problem-Based-Learning. *International Journal of Engineering Education*, 19(5), 742-746.
- Chang, H & Lee, H. (2010), College Students' Decision Making Tendencies in the Context of Socioscientific Issues (SSI). *Korea Assoc. Sci. Edu*, 30(7), 887-900.

- Chattabud, J., Suwannoi, P., Sranamkam, T., Yuenyong, C. (2015). Thai Students' Decision Making in Societal Issue of Surface Area and Concentrated Solutions as a Factor in the Rate of Chemical Reactions. *Mediterranean Journal of Social Sciences*, 6 (6).
- Cheong, F. 2008. Using a Problem-Based Learning Approach to Teach an Intelligent Systems Course. *Journal of Information Technology Education*, 7.
- Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational psychologist*, 49(4), 219-243.
- Dahar, M.D. (1996). *Model-Model Mengajar*. Jakarta: Erlangga.
- Daniel, F. (2017). Kemampuan Berpikir Kritis Siswa Pada Implementasi Project Based Learning (PJBL) Berpendekatan Saintifik. *JPMI (Jurnal Pendidikan Matematika Indonesia)*, 1(1), 7-13.
- Dauer, J., Lute M., & Straka, O. (2017). Indicators of Informal and Formal Decision-making about a Socioscientific Issue. *International Journal of Education in Mathematics, Science and Technology*, 5 (2).
- Dermawan, Rizky. (2006). *Pengambilan Keputusan*. Alfabeta: Bandung.
- Dewi, M. R., Mudakir, I., & Murdiah, S. (2016). Pengaruh Model Pembelajaran Kolaboratif berbasis Lesson Study terhadap Kemampuan Berpikir Kritis Siswa. *Jurnal Edukasi*, 3(2), 29-33.
- Dogru, M. (2008). The Application of Problem-Solving Method on Science Teacher Trainer on Solution of Environmental Problems. *Journal of Environmental & Science Education*, 3(1), 9-18.
- Dolan, E. & Grady, J. (2010). Recognizing Students' Scientific Reasoning: A Tool for Categorizing Complexity of Reasoning During Teaching by Inquiry. *J Sci Teacher Educ*, 21, 31-55.
- Dori, L. T. & Babai, R. (2009). Several CASE Lessons Can Improve Students' Control of Variables Reasoning Scheme Ability. *Journal of Science Education and Technology*, (18), 439-446.
- Duch, B. J. (1996). Problem Solving in Physics: The power of student teaching students. *Journal of Culinary Science Technology*, 326-329.
- Dunca, W. Jack. (1981). *Organizational Behavior Second Edition*. Boston: Houghton Mifflin Company.

- Duron, R., Limbach, B., & Waugh, W. (2006). Critical thinking framework for any discipline. *International Journal of Teaching and Learning in Higher Education*, 17(2), 160-166.
- Eggert, S., & Bögeholz, S. (2009). Students' Use of Decision-Making Strategies With Regard to Socioscientific Issues: An Application of The Rasch Partial Credit Model. *Science Education*, 94(2), 230-258.
- Eggert, S., Ostermeyer, F., Hasselhorn, M., & Bögeholz, S. (2013). Socioscientific decision making in the science classroom: The effect of embedded metacognitive instructions on students' learning outcomes. *Education Research International*, 2013.
- Evagorou, M., Pilar, M., Aleixandre, J., & Osborne, J. (2012). Should We Kill the Grey Squirrels?' A Study Exploring Students' Justifications and Decision-Making. *International Journal of Science Education*, 34 (3), 401–428.
- Facione, P. A., Facione, N. C., Blohm, S.W & Giancarlo, C. A. (2002). Test Manual: The California Critical Thinking Skills Test (Form A, Form B. Form 2000). Millbrae, CA: Insight Assessment/The California Academic Press.
- Febrina, S., & Arief, A. (2011). Efektivitas Penerapan Model Pembelajaran Learning Cycle (Siklus Belajar) 7e terhadap hasil Belajar Peserta didik pada Pokok Bahasan Listrik Dinamis. *Jurnal Inovasi Pendidikan Fisika*. Vol. 2. (3): 243-245.
- Fisher, Alec. (2009). *Critical Thinking: Berpikir Kritis: Sebuah Pengantar*. Penerjemah: Benyamin Hadinata. Jakarta: Penerbit Erlangga.
- Gagne, R.M. (1985). *Problem Solving, the Condition of Learning and Theory of Instruction*. Fourth Edition. Holt-Saunders International Edition.
- Gok, T. & Silay, I. (2008). Effect of Problem Solving Strategies Teaching on The Problem Solving Attitudes of Cooperative Learning Groups in Physics Education. *Journal of Theory and Practice in Education*, 4(2).
- Grace, M., Lee, Y. C., Asshoff, R., Wallin, A. (2015). Student Decision-Making about a Globally Familiar Socioscientific Issue: The Value of sharing and comparing views with international counterparts. *International Journal of Science Education*, 37 (11), 1855–1874.
- Grace, M., & Ratcliffe, M. (2002). The Science and Values That Young People Draw Upon to Make Decision About Biological Conservation Issues. *International Journal of Science Education*, 24(11), 1157-1169.

- Grace, M. (2009). Developing High Quality Decision-Making Discussions About Biological Conservation in a Normal Classroom Setting. *International Journal of Science Education*, 31(4), 551–570
- Gresch, H. & Bögeholz, S.(2013). Identifying Non-Sustainable Course of Action: Prerequisite for Decision Making in Education for Sustainable Development. *Res Sci Educ*,43,733-754.
- Gresch, H., Hasselhorn, M., & Bögeholz, S (2015). Enhancing Decision-Making in STSE Education by Inducing Reflection and Self-Regulated Learning. *Res Sci Educ*.
- Gresch, H., Hasselhorn, M., & Bogeholz, S.(2013). Training in Decision-making Strategies: An approach to enhance students' competence to deal with socioscientific issues. *International Journal of Science Education*, 35(15), 2587–2607.
- Griffin, P., McGaw, B., & Care, E. (2012). *Assessment an teaching 21<sup>st</sup> century skills*. New York: Springer.
- Hadjichambi, D., P., Hadjichambis, A., C., & Konstantinos, K.(2015). How Students' Values are Intertwined with Decisions in a Socio-scientific Issue. *International Journal of Environmental and Science Education*, 10(3), 493-513
- Hake, R. R. (1999). Analyzing change/gain scores. *Unpublished.[online] URL: <http://www.physics.indiana.edu/~sdi/AnalyzingChange-Gain.pdf>*.
- Harris, R. (2012). *Introduction to Decision Making*, Jakarta: Virtualsalt.
- Heller, P., Keith, R., & Anderson, S. (1992). Teaching problem solving through cooperative grouping. Part 1: Group versus individual problem solving. *American journal of physics*, 60(7), 627-636.
- Hoffman, K., & Elwin, C. (2004). The relationship between critical thinking and confidence in decision making. *Australian Journal of Advanced Nursing*, The, 22(1), 8.
- Hong, J., & Chang, N. (2004). Analysis Of Korean High School Students' Decision-Making Processes in Solving A Problem Involving Biological Knowledge. *Research in Science Education*, 34(1), 97–111.
- Järvelä, S., Volet, S., & Järvenoja, H. (2010). Research on motivation in collaborative learning: Moving beyond the cognitive–situative divide and

- combining individual and social processes. *Educational psychologist*, 45(1), 15-27.
- Johnson, L. Dan Lamb, A. 2000. *Critical and Creative thinking-Bloom's Taxonomy*, (Online), diakses 15 Januari 2018, from <http://eduscapes.com>
- Joshi, Manmohan. (2017), *Soft Skills 1st Edition. Bangalore: Senior Trainer Acharya Institute of English & Foreign Languages.*
- Kaniawati, I. (2012). *Metodologi Penelitian Pendidikan Fisika*. UPI Press, Bandung
- Khosa, D. K., & Volet, S. E. (2014). Productive group engagement in cognitive activity and metacognitive regulation during collaborative learning: can it explain differences in students' conceptual understanding?. *Metacognition and Learning*, 9(3), 287-307.
- Kolsto, S. D. (2006). Patterns in students' argumentation confronted with a risk-focused socio-scientific issue. *International Journal of Science Education*, 28(14), 1689–1716.
- Leak, A.E., Rothwell, S.L., Olivera, J., Zwickl, B., Vosburg, J., & Martin, K.N. (2017). Examining Problem Solving in Physics-Intensive. *Physical Review Physics Education Research*, 13(2).
- Lee, Y. C. & Grace, M. (2012). Student's Reasoning and Decision Making About a Socioscientific Issue: A Cross-Context Comparison. *Science Education*, 96 (5), 787–807.
- Levinson, R., Kent, P., Pratt, D., Kapadia, R., & Yogui, C. (2012). Risk-Based Decision Making in a Scientific Issue: A Study of Teachers Discussing a Dilemma Through a *Microworld*. *Science Education*, 96 (2), 212–233.
- Liao, Y. W. & Ching, S.H. (2009). "Enhancing Eight Grade Student's Scientific conceptual change and scientific reasoning through a Web based learning program". *Journal of educational Technology & Society (IFETS)*. 12, (4), 228-240.
- Lindahl, M. G. & Linder, C. (2015). What's Natural About Nature? Deceptive Concepts In Socio Scientific Decision Making. *European Journal of Science and Mathematics Education*, 3(3), 250-264
- Lipman, M. (1995). Good thinking. *Inquiry: Critical Thinking Across the Disciplines*, 15(2), 37-41.

- Marzano, R.J. (1992). *The Rationale and Framework for teaching thinking tactics. Teaching for Thinking, 15-26*. Reston, VA: National Association for Secondary Schools Principals.
- McDermot & Lilian, C. (1990). A perspective on teacher preparation in physics and other sciences. *American Journal of Physics*, 58 (8), 406-417.
- McMurtry & Humphrey. (2000). Decision Making and Problem Solving: Pengambilan Keputusan dan Pemecahan Masalah. Penerjemah: Peni Rahmawati. Jakarta: Penerbit Indeks.
- Mitreviski, B & O.Sajkov.(2012). Physics Lab, Critical Thinking and Gender Difference. *Journal of Macedonian Physics*. 48.
- Michael J. Lawson, David D. & Curtis. (2001) Exploring Collaborative Online Learning, *JALN*. 5(1)
- Osborne, J. & Kind, P.(2016). Styles of Scientific Reasoning: A Cultural Rationale for Science Education?. *Science Education*, 20(10), 1–24.
- Papadouris, Nicos. (2012). Optimization as a Reasoning Strategy for Dealing With Socioscientific Decision-Making Situation. *Science Education*, 96 (4), 600–630.
- Pepkin K.L. (2004). *Creative Problem Solving In Math*. <http://www.uh.edu/hti/cu/2004/v02/04.htm>
- Presseisen, Barbara. (2001). Thinking Skills: Meanings and Models Revisited. Dalam Costa, Arthur (Penyunting). *Developing of Minds*. (hlm. 47-53). Alexandria: Association for Supervision and Curriculum Development.
- Quieng, M. C., Lim, P.P. & Lucas, M. R. D. (2015). 21st Century-based Soft Skills: Spotlight on Non-cognitive Skills in a Cognitive-laden Dentistry Program. *European Journal of Contemporary Education*, 11.
- Radakovic, Nenad.(2015). People Can Go Against the Government: Risk Based Decision Making and High School Students' Concepts of Society. *Canadian Journal Of Science, Mathematics And Technology Education*, 15(3), 276–288.
- Ratcliffe, Mary. (1997). Pupil decision-making about socio-scientific issues within the science curriculum. *Int. J. Sci. Educ*, 19 (2), 167-18
- Sadler, J., & Fawns, R. (1992). Communication on a problem solving task in cooperative learning groups. *Research in Science Education*, 22(1), 417–419



- Sadler, T., & Zeidler, D. (2004). The morality of socio-scientific issues: Construal and resolution of genetic engineering dilemmas. *Science Education*, (88), 4–27.
- Salusu. (1996) .*Pengambilan Keputusan Stratejik*. Jakarta: Gramedia Widiasarana Indonesia.
- Santrock, J.W.2008. *Educational Psychology, 2<sup>nd</sup> Edition*. McGraw-Hill Company.
- Sato, Manabu. (2007). *Tantangan yang Harus Dihadapi Sekolah*, makalah dalam Bacaan Rujukan untuk Lesson Study – Berdasarkan Pengalaman Jepang dan IMSTEP. Jakarta: Sistems.
- Seethaler, S., & Linn, M. (2004). Genetically Modified Food in Perspective: An Inquiry-Based Curriculum to Help Middle School Students Make Sense of Tradeoffs. *International Journal of Science Education*, 26(14), 1765–1785.
- Selcuk, G.S, Caliskan, S., & Erol, M. (2008). The Effect Problem Solving Instruction on Physics Achievement, Problem Solving Performance and Strategy Use.*Lat. Am. J. Phy. Educ.*, 2(3).
- Settelmaier, E. (2003). Dilemmas with Dilemmas... Exploring the suitability of dilemma stories as a way of addressing ethical issues in science education. *Paper presented at the annul meeting of the National Association for Research in Science Teaching, Philadelphia, PA*.
- Settelmaier, E.(2002).Dilemma stories as a way of addressing ethical issues in the context of science education: An evaluation. *Proceedings Science and Mathematics Education Centre (SMEC). Curtin University of Technology*.
- She, H.C. &Liao, Y. W. (2009). Enhancing Eight Grade Students' Scientific Conceptual Change and Scientific Reasoning Through a Web-based Learning Program. *Educational Technology & Society*, 12(4), 228–240.
- Siegel, M. (2006). High School Students' Decision Making About Sustainability. *Environmental Education Research*, 12 (2), 201–215.
- Siribunnam, S., Nuangchalerm, P., Jansawang, N. (2014). Socio-scientific Decision Making in the Science Classroom. *International Journal for Cross-Disciplinary Subjects in Education (IJCDSE)*, 5(4).
- Snyder, L. G., & Snyder, M. J. (2008). Teaching critical thinking and problem solving skills. *The Journal of Research in Business Education*, 50(2), 90.

- Soobard, R & Rannikmäe, M.(2014). Upper Secondary Students`Self-Perceptions of BothTheir Competence iProblem Solving, DecisionMaking and ReasoningWithin Science Subjectsand Their Future Careers. *Journal of Baltic Science Education*, 13 (4).
- Sriyati, S. (2011). *Peran Asesmen Formatif dalam Membentuk Habits of Mind Mahasiswa (Doctoral dissertation, Universitas Pendidikan Indonesia)*.
- Suarsana, I. M. (2013). *Pengembangan e-modul berorientasi pemecahan masalah untuk meningkatkan keterampilan berpikir kritis mahasiswa. JPI (Jurnal Pendidikan Indonesia)*, 2(2).
- Sudiarta, I. G. P. (2007). *Pengembangan Pembelajaran Berpendekatan Tematik Berorientasi Pemecahan Massalah Matematika Terbuka untuk Mengembangkan Kompetensi Berpikr Divergen, Kritis dan Kreatif. Jurnal Pendidikan dan Kebudayaan*, 13(69), 1004-1024.
- Suherman, E. (2008). *Model belajar dan pembelajaran berorientasi kompetensi siswa. Educare*, 5(2).
- Sugiyono. (2008). *Metode Penelitian Kuantitatif, Kualitatif, dan R & D. Bandung: Alfabeta*.
- Splitter, L. J. (2000). *Concepts, communities and the tools of good thinking. Inquiry: Critical Thinking Across the Disciplines*, 19(2), 11-26.
- Suharsimi, A. (2006) *Prosedur Penelitian Suatu Pendekatan Praktek*. Jakarta: Rineka Cipta.
- Suharsimi, A. (2013). *Dasar-dasar Evaluasi Pendidikan*. Jakarta: Bumi Aksara
- Swartz, Robert J.(2001). *Thinking About Decision*. Dalam Costa, Arthur (Penyunting). *Developing of Minds*.( hlm. 58-66). Alexandria: Association for Supervision and Curriculum Development.
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive science*, 12(2), 257-285
- Tekbiyik, A. (2015). The Use of Jigsaw Collaborative Learning Method in Teaching Socioscientific Issues: The Case of Nuclear Energy. *Journal of Baltic Science Education*, 14 (2).
- Thiagarajan, S., Semmel, D. S. & Semmel, M. (1974). *Instructional Development for Training Teacher of Exceptional Children. Source Book. Bloominton: Center for Innovation on Teaching the Handicapped*.

- Tiruneh, D. T. Cock, M. D, Elen, J. (2017), Designing Learning Environments for Critical Thinking: Examining Effective Instructional Approaches, *Int J of Sci and Math Educ*, DOI 10.1007/s10763-017-9829-z.
- Tiruneh, D. T. et.al. (2017), Measuring Critical Thinking in Physics: Development and Validation of a Critical Thinking Test in Electricity and Magnetism, *Int J of Sci and Math Educ* 15:663-682, Springer.
- Tiruneh, D. T. et.al. (2016), Systematic design of a learning environment for domain-specific and domain-general critical thinking skills, *Education Tech Research Dev* 64:481–505 Springer.
- Tiruneh, D. T. et.al. (2017). Toward a Systematic and Model-Based Approach to Design Learning Environments for Critical Thinking, Learning, Design and Technology, Springer.
- Treffinger, D. J., Isaksen, S. G., & Stead-Dorval, K. B. (2005). Creative problem solving: An introduction. Prufrock Press Inc.
- Treffinger, D. J., & Isaksen, S. G. (2005). Creative problem solving: The history, development, and implications for gifted education and talent development. *Gifted Child Quarterly*, 49(4), 342-353.
- Walker, Marquita. (2013). Evaluating the Intervention of an Ethics' Class in Students' Ethical Decision-Making: A Summative Review. *International Education Studies*, 6 (1).
- W.S. Winkel, C. (1996). Psikologi Pendidikan & Evaluasi Belajar. Jakarta: PT Gramedia.
- Wood, D. (2003). *Problem Based Learning: ABC of Learning and Teaching in Medicine*. [Online].Tersedia pada [http://www.bmj.com/cgi/content/full/326/7384/328/\[24 Maret 2018\]](http://www.bmj.com/cgi/content/full/326/7384/328/[24%20Maret%202018]).
- Wood, Jack., Joseph Wallace, Rachid M. Zeffane, David J. Kennedy, John R. Schermerhorn, Jr., James G (Jerry) Hunt and Richard N. Osborn.(1998). *Organizational Behavior: An Asian Pacific Perspective. Australian Edition*. Singapore: John Wiley & Sons.
- Yuenyong, Chokchai. (2012).Thai Students' Decision Making about Energy Issues: The Influence of Local Values. *Procedia - Social and BehavioralSciences*, 46, 5045-5057
- Zo`bi, Abdallah Salim. (2014). The Effect of Using Socio-Scientific Issues Approach in Teaching Invorenmental Issues on Improving the Student's

Ability of Making Appropriate Decision Towards These Issues. *International Education Studies*, 7(8).