# PENGEMBANGAN INSTRUMEN PENILAIAN KINERJA UNTUK MENGUKUR KEMAMPUAN *TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE* (TPACK) CALON PENDIDIK KIMIA

**TESIS**

**Diajukan untuk Memenuhi Sebagian dari Syarat untuk Memperoleh Gelar Magister Pendidikan Kimia**


**Oleh**

**Ninda Permasari**

**2105105**

**PROGRAM STUDI**

**MAGISTER PENDIDIKAN KIMIA**

**FAKULTAS PENDIDIKAN MATEMATIKA DAN IPA**

**UNIVERSITAS PENDIDIKAN INDONESIA**


**2024**

**PENGEMBANGAN INSTRUMEN PENILAIAN KINERJA UNTUK MENGUKUR KEMAMPUAN *TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE* (TPACK) CALON PENDIDIK KIMIA**

**Oleh:**

**Ninda Permasari**

**NIM 2105105**

**Sebuah tesis yang diajukan untuk memenuhi salah satu syarat memperoleh gelar**

**Magister Pendidikan Program Studi Pendidikan Kimia**

**Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam**

**© Ninda Permasari 2024**

**Universitas Pendidikan Indonesia**

**Februari 2024**

**Hak cipta dilindungi Undang-undang**

**Tesis ini tidak boleh diperbanyak seluruhnya atau sebagian dengan dicetak ulang, di*fotocopy* atau cara lainnya tanpa seizin penulis.**

**LEMBAR PENGESAHAN TESIS**

**NINDA PERMASARI**

**2105105**

**PENGEMBANGAN INSTRUMEN PENILAIAN KINERJA UNTUK MENGUKUR KEMAMPUAN *TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE* (TPACK) CALON PENDIDIK KIMIA**

**Disetujui dan disahkan oleh**
**Pembimbing I**

**Prof. Dr. Nahadi, M.Pd., M.Si**
**NIP. 197102041997021002**

**Pembimbing II**

**Dr. Hernani, M.Si**
**NIP. 196711091991012001**

**Mengetahui,**
**Ketua Program Studi Magister Pendidikan Kimia**
**FPMIPA UPI**

**Dr. Wiji, M.Si**
**NIP. 197204302401121001**



Dipindai dengan CamScanner

## PERNYATAAN

Dengan ini saya menyatakan bahwa tesis dengan judul "Pengembangan Instrumen Penilaian Kinerja Untuk Mengukur Kemampuan *Technological Pedagogical Content Knowledge* (TPACK) Calon Pendidik Kimia" beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung risiko/sanksi apabila di kemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

Bandung, Februari 2023

Yang membuat pernyataan

Ninda Permasari

2105105

## UCAPAN TERIMA KASIH

Puji syukur atas rahmat dan karunia Allah SWT sehingga penulis dapat menyelesaikan tesis yang berjudul "Pengembangan Instrumen Penilaian Kinerja Untuk Mengukur Kemampuan *Technological Pedagogical Content Knowledge* (TPACK) Calon Pendidik Kimia" Dalam penyusunan tesis, penulis banyak mendapatkan bantuan dan bimbingan dari berbagai pihak. Oleh karena itu, penulis ingin menyampaikan ucapan terima kasih kepada:

1. Bapak Prof. Dr. Nahadi, M.Pd., M.Si dan Ibu Dr. Hernani, M.Si dosen pembimbing pertama dan pembimbing kedua yang telah memberikan ilmu, masukan, saran, bimbingan, dan motivasi dalam penyusunan desain tesis.
2. Bapak Dr. Wiji, M.Si dan Ibu Dr. Tuszie Widhiyanti, M.Pd selaku ketua program studi dan sekretaris program studi pendidikan kimia yang turut memberikan dorongan pelaksanaan penelitian ini.
3. Ibu Dr. Hairida, M.Pd, bapak Rahmat Rasmawan, M.Pd, serta bapak Lukman Hadi, M.Pd membantu dalam finalisasi instrumen penelitian.
4. Dini Dwi Apriani, M.Pd, Elginda Yusa Arniezca, M.Pd dan Pandu Eka Putra Ariana, M.Pd telah berkenan menjadi *rater* dalam uji coba instrumen
5. Mahasiswa pendidikan kimia UPI pada mata kuliah Perencanaan Pembelajaran Kimia (PPK) yang telah bekerja sama dalam penelitian.
6. Bapak Febrizal, M.Pd., ibu Purwanti, M.Pd., Adek Diah Murti, M.Pd serta Nurul Amali, M.Pd yang selalu memberikan bantuan, motivasi dan teman diskusi dalam penulisan tesis ini.

Kedua orang tua yaitu bapak Mochtaram dan ibu Rahmah serta saudara kandung yaitu Chandra Prayudi dan Indra Dinata yang telah menjadi pendukung nomor satu, senantiasa berdoa dan memberikan dukungan baik moril maupun materil serta motivasi dalam penulisan tesis ini.

# KATA PENGANTAR

Puji syukur atas rahmat dan karunia Allah SWT yang telah menurunkan Al-qur'an sebagai sumber ilmu serta shalawat dan salam kepada Rasulullah Muhammad SAW yang mengubah pola pikir manusia dari pola pikir Islamiyah sehingga menjadi contoh teladan yang baik. Sehingga penulis dapat menyelesaikan Tesis yang berjudul "Pengembangan Instrumen Penilaian Kinerja Untuk Mengukur Kemampuan *Technological Pedagogical Content Knowledge* (TPACK) Calon Pendidik Kimia". Penyusunan tesis ini diajukan sebagai syarat untuk memperoleh gelar Magister Pendidikan pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam, Universitas Pendidikan Indonesia.

Penulis telah berusaha dengan maksimal dalam menyusun desain penelitian ini, namun penulis menyadari bahwa desain penelitian ini masih terdapat banyak kesalahan, oleh karena itu, diharapkan kritik dan saran yang bersifat membangun untuk memperbaiki desain penelitian ini. Akhir kata penulis berharap agar instrumen penelitian ini dapat berguna dan memberikan manfaat yang baik bagi semua pihak.

Bandung, Februari 2024

Penulis

## ABSTRAK

Tujuan dari penelitian ini adalah untuk mengembangkan instrumen penilaian kinerja *Technological Pedagogical Content Knowledge* (TPACK) untuk menilai rancangan pembelajaran yang disusun oleh mahasiswa calon pendidik kimia. Metode penelitian yang digunakan adalah *Design and Development Research* (DDR) dengan tiga tahapan besar yaitu *design, development and evaluation*. Hasil penelitian menunjukkan; 1) pada tahap perencanaan (*Design*) dihasilkan definisi, indikator, dan *task* dalam membuat perencanaan pembelajaran. Instrumen penilaian kinerja berupa penilaian lembar observasi dilengkapi rubrik penilaian, dan survei berupa penilaian sendiri. Instrumen *self assessment* terdiri dari 21 pernyataan; 2) pada tahap pengembangan (*Development*) dihasilkan draf awal instrumen berupa kisi-kisi instrumen, rubrik penilaian, dan angket pernyataan yang valid secara konten (isi), dan konstruk; 3) tahap evaluasi (*Evaluation*) dihasilkan instrumen yang rubrik teruji secara validitas, dan reliabilitas. *Draft* instrumen yang dirancang dilakukan uji kualitas secara validitas isi, dan konstruk pada item pernyataan. Korelasi pearson untuk *self assessment* diperoleh nilai sebesar 0,547-0,768 dengan jumlah responden 14 mahasiswa sehingga r tabel 0,532 instrumen *self assessment* dikatakan valid karena nilai r hitung lebih besar dari t tabel. Reliabilitas Alfa Cronbach pada *self assessment* diperoleh setiap domain sebesar 0,701 hingga 0,876. Reliabilitas lembar observasi indeks ICC berkisar 0,503 hingga 0,919, dan W Kendall 0,607 hingga 0,939. Instrumen yang telah dikembangkan dapat dikatakan akurat dalam mengukur penilaian kinerja TPACK mahasiswa calon pendidik. Perbandingan antara hubungan penilaian *self assessment*, dan lembar observasi dilakukan dengan uji korelasi non parametrik Spearman dengan korelasi tertinggi pada domain CK, dan domain TCK yaitu sebesar 1, dan 0,553.



**Kata Kunci**: TPACK, penilaian kinerja, perencanaan pembelajaran, calon pendidik kimia, rubrik penilaian, *self assessment*, lembar observasi

ABSTRACT

*The aim of this research is to develop a performance assessment instrumentTechnological Pedagogical Content Knowledge (TPACK) in assessing learning plans prepared by prospective chemistry teaching students. The research method used isDesign and Development Research (DDR) with three major stages, namely design, development and evaluation. The research results show; 1) at the planning stage (Design) produced definitions, indicators and tasks in making learning plans. The performance assessment instrument is in the form of an observation sheet with an assessment rubric and a survey in the form of self-assessment. Instrument Self assessment consists of 21 statements; 2) at the development stage (Development) an initial draft of the instrument is produced in the form of an instrument grid, assessment rubric and statement questionnaire that is content and construct valid. Evaluation stage (Evaluation) produced an instrument with a rubric for validity and reliability.Draft The designed instrument was tested for quality in terms of content and construct validity on the statement items. Pearson correlation for self assessment The value obtained was 0.547-0.768 with a total of 14 students responding so that the r table was 0.532 for the instrument self assessment is said to be valid because the calculated r value is greater than the t table. Cronbach's Alpha Reliability in self assessment obtained for each domain was 0.701 to 0.876. The reliability of the ICC index observation sheet ranges from 0.503 to 0.919 and Kendall's W from 0.607 to 0.939. The instrument that has been developed can be said to be accurate in measuring the TPACK performance assessment of prospective teaching students. Comparison between assessment relationships, self assessment and the observation sheet was carried out using the Spearman nonparametric correlation test with the highest correlation in the CK domain and TCK domain, namely 1 and 0.553.*

***Keywords**: TPACK, performance assessment, lesson planning, chemistry teacher candidates, assessment rubric, self-assessment, observation*

## DAFTAR ISI

**PERNYATAAN** ..... **iv**

**UCAPAN TERIMA KASIH** ..... **v**

**KATA PENGANTAR** ..... **vi**

**ABSTRAK** ..... **vii**

**DAFTAR ISI** ..... **ix**

**DAFTAR TABEL** ..... **xii**

**DAFTAR GAMBAR** ..... **xiv**

**DAFTAR LAMPIRAN** ..... **xvi**

**BAB I** ..... **1**

**PENDAHULUAN** ..... **1**

**1.1 Latar Belakang** ..... **1**

**1.2 Rumusan Masalah** ..... **6**

**1.3 Pembatasan Masalah** ..... **6**

**1.4 Tujuan Penelitian** ..... **7**

**1.5 Manfaat Penelitian** ..... **7**

**1.6 Struktur Organisasi Tesis** ..... **8**

**BAB II** ..... **10**

**KAJIAN PUSTAKA** ..... **10**

**2.1 *Technological Pedagogical Content Knowledge* (TPACK)** ..... **10**

**2.1.1. *Technological Knowledge*** ..... **12**

**2.1.2. *Content Knowledge*** ..... **13**

**2.1.3. *Pedagogical Knowledge*** ..... **13**

**2.1.4. *Pedagogical Content Knowledge*** ..... **14**

**2.1.5. *Technological Content Knowledge*** ..... **14**

**2.1.6. *Technological Pedagogical Knowledge*** ..... **15**

**2.1.7. *Technological Pedagogical Content Knowledge*** ..... **16**

**2.2 Pengembangan *Performance Assessment*** ..... **17**

**2.3 Instrumen-instrumen dalam mengukur TPACK** ..... **19**

**2.3.1.*Self-Report Measures*** ..... **19**
**2.3.2.*Open-Ended Questionnaires*** ..... **19**
**2.3.3.*Performance Assessments*** ..... **20**
**2.3.4.*Interview*** ..... **20**
**2.3.5.*Observation*** ..... **21**
**2.4 Asesmen kinerja dalam mengukur rancangan pembelajaran** ..... **21**
**2.4.1 Tugas Kinerja** ..... **25**
**2.4.2 Rubrik Penilaian Kinerja** ..... **26**
**2.5 Mata Pelajaran Kimia yang harus dikuasai Peserta Didik** ..... **27**
**2.6 Capaian Pembelajaran Program Studi Pendidikan Kimia** ..... **29**
**BAB III** ..... **31**
**METODE PENELITIAN** ..... **31**
**3.1 Desain Penelitian** ..... **31**
**3.1.1.Perencanaan (*Design*)** ..... **31**
**3.1.2.Pengembangan (*Development*)** ..... **32**
**3.1.3.Evaluasi (*Evaluation*)** ..... **32**
**3.2 Subjek, Tempat, dan Lama Penelitian** ..... **33**
**3.3 Prosedur Penelitian** ..... **33**
**3.4 Instrumen dan Data Penelitian** ..... **35**
**3.5 Analisis Data Pengembangan Instrumen** ..... **36**
**3.5.1 Analisis Dokumen** ..... **36**
**3.5.2 Validitas Instrumen** ..... **37**
**3.5.3.Reliabilitas Instrumen (*Interrater Reliability*)** ..... **38**
**3.5.4 Hubungan Penilaian Diri dan Lembar Observasi (*langsung ICC dan W Kendall)*** ..... **44**
**BAB IV** ..... **46**
**TEMUAN DAN PEMBAHASAN** ..... **46**
**4.1. Pengembangan Instrumen Penilaian Kinerja TPACK** ..... **46**
**4.2. Kualitas Instrumen Penilaian Berdasarkan Validitas** ..... **50**
**4.4.1.Lembar Observasi** ..... **50**
**4.4.2.*Self Assessment*** ..... **65**

**4.3. Kualitas Instrumen Penilaian TPACK Berdasarkan Reliabilitas ..... 70**
**4.4. Hubungan antara Penilaian Diri dan Lembar Observasi ..... 75**
**4.4.1 Aspek CK pada penilaian observasi ..... 76**
**4.4.2 Aspek PK pada penilaian observasi..... 77**
**4.4.3 Aspek TK pada penilaian observasi ..... 80**
**4.4.4 Aspek PCK pada penilaian observasi..... 83**
**4.4.5 Aspek TCK pada penilaian observasi..... 85**
**4.4.6 Aspek TPK pada penilaian observasi ..... 90**
**4.4.7 Aspek TPACK pada penilaian observasi ..... 94**
**BAB 5 ..... 106**
**SIMPULAN, IMPLIKASI, DAN REKOMENDASI ..... 106**
**5.1 Simpulan..... 106**
**5.2 Implikasi..... 106**
**5.3 Rekomendasi..... 107**
**DAFTAR PUSTAKA..... 108**

## DAFTAR TABEL

Tabel 2. 1 Peraturan-peraturan Penyusunan Rencana Pembelajaran ..... 23
Tabel 2. 2 Contoh *Analytic Rubrics* ..... 26
Tabel 2. 3 Kompetensi kimia kelas X-XI ..... 28
Tabel 3. 1 Instrumen, dan Data Penelitian ..... 35
Tabel 3. 2 Analisis Data Pengembangan Instrumen ..... 36
Tabel 3. 3 Interpretasi Nilai r Tabel ..... 38
Tabel 3. 4 Contoh Indeks Konsistensi antar Penilai yang Cocok digunakan berdasarkan Jenis Data ..... 39
Tabel 3. 5 Interpretasi Nilai Indeks ICC ..... 41
Tabel 3. 6 Interpretasi Nilai Indeks W Kendall ..... 43
Tabel 3. 7 Interpretasi Nilai Alpha Cronbach ..... 43
Tabel 3. 8 Interpretasi Nilai Koefisien Korelasi ..... 45
Tabel 4. 1 Definisi Operasional Penilaian Kinerja TPACK ..... 46
Tabel 4. 2 Aspek Penilaian Kinerja Framework TPACK ..... 47
Tabel 4. 3 Kesesuaian antara *Task* dengan Aspek Kinerja yang dinilai ..... 49
Tabel 4. 4 Hasil Revisi Instrumen Lembar Observasi Domain CK ..... 51
Tabel 4. 5 Hasil Revisi Instrumen Lembar Observasi Domain PK ..... 53
Tabel 4. 6 Hasil Revisi Instrumen Lembar Observasi Domain TK ..... 55
Tabel 4. 7 Hasil Revisi Instrumen Lembar Observasi Domain PCK ..... 57
Tabel 4. 8 Hasil Revisi Instrumen Lembar Observasi Domain TCK ..... 59
Tabel 4. 9 Hasil Revisi Instrumen Lembar Observasi Domain TPK ..... 61
Tabel 4. 10 Hasil Revisi Instrumen Lembar Observasi Domain TPACK ..... 63
Tabel 4. 11 Saran-saran Ahli dalam Kegiatan Validasi Isi ..... 66
Tabel 4. 12 Validitas *Self Assessment* TPACK ..... 69
Tabel 4. 13 Reliabilitas Instrumen Penilaian Kinerja CK, PK, TK ..... 70
Tabel 4. 14 Reliabilitas Instrumen Penilaian Kinerja PCK, TCK, TPK, TPACK 71
Tabel 4. 15 Reliabilitas Instrumen *Self Assessment* Kinerja TPACK ..... 73

Tabel 4. 16 Reliabilitas Instrumen *Self Assessment* ..... 74

Tabel 4. 17 Instrumen penilaian sikap RPP mahasiswa materi larutan penyangga ..... 96

Tabel 4. 18 Aspek penilaian kognitif atau pengetahuan ..... 97

Tabel 4. 19 Penilaian Aspek Psikomotorik pada Materi Larutan Penyangga..... 99

Tabel 4. 20 Uji Korelasi Nonparametrik Spearman..... 102

Tabel 4. 21 Perbandingan Penilaian Kinerja *Self Assessment* dan Lembar Observasi..... 103

## DAFTAR GAMBAR

Gambar 2. 1 Kerangka TPACK, dan komponen pengetahuannya (Mishra & Koehler, 2008) ..... 11

Gambar 3. 1Model Pengembangan Intrumen Penilaian Kinerja dalam Mengukur TPACK ..... 34

Gambar 4. 1 Nilai CVR pada Domain CK Rubrik Penilaian ..... 51

Gambar 4. 2 Nilai CVR pada Domain PK Rubrik Penilaian ..... 53

Gambar 4. 3 Nilai CVR pada Domain TK Rubrik Penilaian ..... 55

Gambar 4. 4 Nilai CVR pada Domain PCK Rubrik Penilaian ..... 57

Gambar 4. 5 Nilai CVR pada Domain TCK Rubrik Penilaian ..... 59

Gambar 4. 6 Nilai CVR pada Domain TPK Rubrik Penilaian ..... 61

Gambar 4. 7 Nilai CVR pada Domain TPACK Rubrik Penilaian ..... 63

Gambar 4. 8 Hasil CVR Instrumen *Self Assessment* kerangka TPACK ..... 65

Gambar 4. 9 Kegiatan Pembelajaran Materi Struktur Atom ..... 80

Gambar 4. 10 File Mahasiswa Penggunaan Berbagai Aplikasi Membuat Rencana Pembelajaran ..... 81

Gambar 4. 11 File Mahasiswa dalam Menuliskan Sumber Gambar yang Digunakan ..... 81

Gambar 4. 12 Sumber Belajar dalam Perencanaan Pembelajaran oleh mahasiswa ..... 82

Gambar 4. 13 Rangkaia sel Volta Berbahan Dasar Lemon RPP Mahasiswa ..... 84

Gambar 4. 14 Gambar Peta Konsep Rencana Pembelajaran pada Materi Termokimia ..... 86

Gambar 4. 15 Penggunaan QR Code, dan Link pada Youtube, Power Point, dan Bahan Ajar dalam pembuatan LKPD oleh mahasiswa pada materi termokimia .. 87

Gambar 4. 16 Informasi Tambahan dalam Pembuatan LKPD Oleh Mahasiswa Pada Materi Titrasi Asam Basa ..... 88

Gambar 4. 17 Penggunaan Link Presensi Online dalam Skenario Pembelajaran. 88

Gambar 4. 18 Penggunan Link YouTube pada Kegiatan Inti Skenario Pembelajaran ..... 89

Gambar 4. 19 Penggunaan *Link Self* & *Peer Assessment* Skenario Pembelajaran Mahasiswa pada Materi Elektrolisis ..... 89

Gambar 4. 20 Teknik, dan Instrumen Penilaian Mahasiswa dalam Perencanaan Pembelajaran ..... 90

Gambar 4. 21 Instrumen Penilaian Mahasiswa Materi Hukum Dasar Kimia..... 91

Gambar 4. 22 Link Atau Kode QR LKPD Mahasiswa Materi Kimia Unsur (Alkali) ..... 92

Gambar 4. 23 LKPD Mahasiswa Materi Golongan Alkali ..... 93

Gambar 4. 24 Aspek Makromolekul, Mikromolekul, dan Simbolik ..... 95

Gambar 4. 26 Grafik Penilaian Kinerja TPACK Lembar Observasi ..... 100

Gambar 4. 27 Grafik penilaian kinerja *self assessment* ..... 101

Gambar 4. 28 Perbandingan Penilaian Kinerja, dan Penilaian diri..... 104

## DAFTAR LAMPIRAN

Lampiran 1.Lembar Validasi Instrumen Penilaian Lembar Observasi ..... 121
Lampiran 2 Lembar Validasi Isi Instrumen Penilaian Diri ..... 144
Lampiran 3 Instrumen Final Penilaian Kinerja Lembar Observasi ..... 152
Lampiran 4 Isntrumen Final *Self Assessment* TPACK ..... 157
Lampiran 5 Instrumen Penilaian Lembar Observasi ..... 160
Lampiran 6 Instrumen Penilaian *Self Assessment* Kinerja TPACK ..... 170
Lampiran 7 Hasil CVR Lembar Observasi ..... 171
Lampiran 8 Hasil CVR *Self Assessment* TPACK ..... 172
Lampiran 9 Penilaian Lembar Observasi oleh Master Pendidikan Kimia, dan Peneliti ..... 173
Lampiran 10 Data *Self Assessment* Google Form ..... 177
Lampiran 11 Link Google Drive SPSS ..... 178
Lampiran 12. Artikel-artikel yang digunakan dalam analisis bibliometri ..... 186
Lampiran 13 RPS Perencanaan Pembelajaran Kimia (PPK) ..... 194
Lampiran 14 Surat Izin Penelitian ..... 212

# DAFTAR PUSTAKA

A Putra, N. T., Kartini, K., & Widiyaningsih, N. (2019). Implementasi Media Pembelajaran Interaktif Berbasis Mobile Pada Materi Hidrokarbon. *Jurnal Pendidikan Kimia Indonesia*, *4*(2), 43–52.

Adu-Gyamfi, K., & Asaki, I. A. (2022). Teachers' Conceptual Difficulties in Teaching Senior High School Organic Chemistry. *Contemporary Mathematics and Science Education*, *3*(2), ep22019. https://doi.org/10.30935/conmaths/12382

Akyuz, D. (2018). Measuring technological pedagogical content knowledge (TPACK) through performance assessment. *Computers and Education*, *125*, 212–225. https://doi.org/10.1016/j.compedu.2018.06.012

Alayyar, G. M., Fisser, P., & Voogt, J. (2012). Developing technological pedagogical content knowledge in pre-service science teachers: Support from blended learning. *Australasian Journal of Educational Technology*, *28*(8). https://doi.org/10.14742/ajet.773

Amin, I., Waluyo, St. B., Sukestiyarno, & Mariani, Sc. (2022). *Development of Self-Evaluation Instrument in the Implementation of PME (Planning-Monitoring-Evaluating) Learning Model to Evaluate Metacognitive Performance:* 6th International Conference on Science, Education and Technology (ISET 2020), Semarang, Indonesia. https://doi.org/10.2991/assehr.k.211125.092

Anci, F. F., Paristiowati, M., Budi, S., Tritiyatma H., & Fitriani, E. (2021). *Development of TPACK of chemistry teacher on electrolyte and non-electrolyte topic through lesson study*. 040038. https://doi.org/10.1063/5.0041804

Anggrella, D. P., Izzati, L. R., & Sudrajat, A. K. (2023). *Improving the quality of learning through lesson plan preparation workshops for an independent learning model*. *4*(1).

Anthony, J. N., & Brookhart, S. (2007). *Educational Assessment of Students*. Pearson Merrill Prentice Hall.

Arrigo, V., Lorencini Júnior, Á., & Broietti, F. C. D. (2022). The Pedagogical Content Knowledge (PCK) of a Chemistry Student Teacher: An Experience in Pre-Service Education. *International Journal of Research in Education and Science*, *8*(1), 167–186. https://doi.org/10.46328/ijres.2560

Aulannisa, S., Supriana, A., & Hendayana, S. (2022). Development of Sharing and Jumping Task Lesson Design on the Topic of Balancing Chemical Equations to Identify Student's Collaborative Skills. *The 13th Indonesia Conference on Lesson Study (ICLS) Conference Proceeding*, 62–69.

Backfisch, I., Lachner, A., Hische, C., Loose, F., & Scheiter, K. (2020). Professional knowledge or motivation? Investigating the role of teachers' expertise on the quality of technology-enhanced lesson plans. *Learning and Instruction*, *66*, 101300. https://doi.org/10.1016/j.learninstruc.2019.101300

Bahtiar, B., Yusuf, Y., Doyan, A., & Ibrahim, I. (2023). Trend of Technology Pedagogical Content Knowledge (TPACK) Research in 2012-2022: Contribution to Science Learning of 21st Century. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 39–47. https://doi.org/10.29303/jppipa.v9i5.3685

Bawack, R. E. (2020). The role of digital information use on student performance and collaboration in marginal universities. *International Journal of Information Management*.

Becerra, J. R., Jensen, L. C., Diaz, T., Druker, S., Padilla, V. B., Pernaa, H., & Aksela, M. (2020). Developing technological pedagogical science knowledge through educational computational chemistry: A case study of pre-service chemistry teachers' perceptions. *Chemistry Education and Practice*, *3*(8). https://doi.org/DOI: 10.1039/c9rp00273a

Belmawa.kemendikbud. (2020). *Panduan penyusunan kurikulum pendidikan tinggi* [Go.id]. dikti.kemendikbud. https://dikti.kemdikbud.go.id/wp-content/uploads/2020/10/BUKU-PANDUAN-PENYUSUNAN-KURIKULUM-PENDIDIKAN-TINGGI-MBKM.pdf

Boz, Y., & Belge-Can, H. (2020). Do pre-service chemistDo Pre-service Chemistry Teachers' Collective Pedagogical Content Knowledge Regarding Solubility Concepts Enhance ary teachers' collective PCK regarding solubility concepts enhance after participating in a microteaching lesson-study? *Science Education International*, *31*(1), 29–40. https://doi.org/10.33828/sei.v31.i1.4

Calacar, B. G. (2020). Teaching the 2st Century Skills: Theacher's Competence, Practices, and Challenges. *Journal of World Englishes and Educational Practices (JWEEP)*, *2*(2), 81–91.

Carpendale, J., Delaney, S., & Rochette, E. (2020). Modeling Meaningful Chemistry Teacher Education Online: Reflections from Chemistry Preservice Teacher Educators in Australia. *Journal of Chemical Education*, *97*(9), 2534–2543. https://doi.org/10.1021/acs.jchemed.0c00718

Cetin-Dindar, A., Boz, Y., Yildiran Sonmez, D., & Demirci Celep, N. (2018). Development of pre-service chemistry teachers' technological pedagogical content knowledge. *Chemistry Education Research and Practice*, *19*(1), 167–183. https://doi.org/10.1039/C7RP00175D

Creswell, J. (2015). *Riset Pendidikan :Perencanaan, Pelaksanaan dan Evaluasi Riset Kualitatif dan Kuantitatif*. Pustaka Pelajar.

D. Vallespin, M. R., & S. Prudente, M. (2023). Bibliometric Mapping Of Tpack Research Framework From 2006 To 2023. *International Journal of Advanced Research*, *11*(04), 512–522. https://doi.org/10.21474/IJAR01/16687

De Barros Ahrens, R., Da Silva Lirani, L., & De Francisco, A. C. (2020). Construct Validity and Reliability of the Work Environment Assessment Instrument WE-10. *International Journal of Environmental Research and Public Health*, *17*(20), 7364. https://doi.org/10.3390/ijerph17207364

Deng, F., Chai, C. S., So, H. J., Qian, Y., & Chen, L. (2017). Examining the validity of the technological pedagogical content knowledge (TPACK) framework for preservice chemistry teachers. *Australasian Journal of Educational Technology*, *33*(3), 1–14. https://doi.org/10.14742/ajet.3508

Doddy. (2023, September 7). Permendikbudristek Nomor 53 Tahun 2023, Perguruan Tinggi Fleksibel Kembangkan Standar Kompetensi Lulusan. *Humas Ditjen Diktiristek*. https://dikti.kemdikbud.go.id/kabar-dikti/kabar/permendikbudristek-nomor-53-tahun-2023-perguruan-tinggi-fleksibel-kembangkan-standar-kompetensi-lulusan/

Dorfman, B. S., Terrill, B., Patterson, K., Yarden, A., & Blonder, R. (2019). Teachers personalize videos and animations of biochemical processes: Results from a professional development workshop. *Chemistry Education Research and Practice*, *20*(4), 772–786. https://doi.org/10.1039/c9rp00057g

Engida, T. (2014). *Chemistry teacher professional development using the technological pedagogical content knowledge (TPACK) framework*.

Erwin, E. (2020). *Pengembangan Instrumen Asesmen Pedagogical Content Knowledge Calon Guru Fisika Dalam Konteks Pembelajaran Keterampilan Komunikasi dan Penyelesaian Masalah Saintifik* [Disertasi, Universitas Pendidikan Indonesia]. http://repository.upi.edu/41524/. http://repository.upi.edu/41524/

Farjon, D., Smits, A., & Voogt, J. (2019). Technology integration of pre-service teachers explained by attitudes and beliefs, competency, access, and

experience. *Computers & Education*, *130*, 81–93. https://doi.org/10.1016/j.compedu.2018.11.010

Fazilla, S., Yus, A., & Muthmainnah, M. (2022). Digital Literacy and TPACK's Impact on Preservice Elementary Teachers' Ability to Develop Science Learning Tools. *Profesi Pendidikan Dasar*, *9*(1), 71–80. https://doi.org/10.23917/ppd.v9i1.17493

Feng, L., & Mustapha, S. M. (2023). Bibliometric Analysis (2012-2022) of Research Hotspots and Trends on Technological Pedagogical and Content Knowledge in China. *European Journal of Computer Science and Information Technology*, *11*(3), 24–43. https://doi.org/10.37745/ejcsit.2013/vol11n32443

Frey, B., Schmitt, V., & Alllen, J. (2012). Defining authentic classroom assessment. *Practical Assessment Research & Evaluation*, *17*(2), 1–18.

Giana, E., & Adnan, A. (2022). *Exploring Vocational School English Teachers' Technological*. *11*(4).

Gisev, N., Bell, J. S., O'Reilly, C. L., Rosen, A., & Chen, T. F. (2010). An expert panel assessment of comprehensive medication reviews for clients of community mental health teams. *Social Psychiatry and Psychiatric Epidemiology*, *45*(11), 1071–1079. https://doi.org/10.1007/s00127-009-0148-8

Gisev, N., Hons, B. P., Bell, J. S., Ph, D., Chen, T. F., & Ph, D. (2013). Interrater agreement and interrater reliability: Key concepts , approaches , and applications. *Research in Social and Administrative Pharmacy*, *9*(3), 330–338. https://doi.org/10.1016/j.sapharm.2012.04.004

Graham, C. R., Borup, J., & Smith, N. B. (2012). Using TPACK as a framework to understand teacher candidates' technology integration decisions. *Journal of Computer Assisted Learning*, *28*(6), 530–546. https://doi.org/10.1111/j.1365-2729.2011.00472.x

Graham, C. R., Tripp, T., & Wentworth, N. (2009). Assessing and Improving Technology Integration Skills for Preservice Teachers Using The Teacher Work Sample. *Journal Educational Computing Research*, *41*(1), 39–62. https://doi.org/10.2190/EC.41.1.b

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Handayani, S., Hussin, M., & Norman, H. (2023). Technological Pedagogical Content Knowledge (TPACK) Model in teaching: A Review and Bibliometric Analysis. *Pegem Journal of Education and Instruction*, *13*(3). https://doi.org/10.47750/pegegog.13.03.19

Hanson, R. (2017). Enhancing Students ' Performance in Organic Chemistry Through Context- Based Learning and Chemistry Through Context-Based Learning. *European Journal of Research and Reflection in Educational Sciences*, *5*(November), 7–20.

Harris, J. B., Grandgenett, N., & Hofer, M. (2010). Testing a TPACK-Based Technology Integration Assessment Rubric. *Teacher Education Faculty Proceedings & Presentations*.

Haynes, S. N., Richard, D. C. S., & Kubany, E. S. (2005). Content validity in psychological assessment, A functional approach to concepts and methods. *Psychological Assessment*, *7*(3), 238–247. https://doi.org/10.30935/cedtech/5962

Hejji Alanazi, M. (2019). A Study of the Pre-Service Trainee Teachers Problems in Designing Lesson Plans. *Arab World English Journal*, *10*(1), 166–182. https://doi.org/10.24093/awej/vol10no1.15

Hillier, J. G., Martin, P. R., & Redfern, P. H. (1975). Proceedings: A possible interaction between the 24H rhythms in catecholamine and 5-hydroxytryptamine concentration in the rat brain. *The Journal of Pharmacy and Pharmacology*, *27 Suppl?-2*, 40P.

Hsu, P. S. (2012). Examining the impact of educational technology courses on pre-service teachers' development of technological pedagogical content knowledge. *Teaching Education*, *23*(2), 195–213. https://doi.org/10.1080/10476210.2011.622041

Iqbal, Md. H., Siddiqie, S. A., & Mazid, Md. A. (2021). Rethinking theories of lesson plan for effective teaching and learning. *Social Sciences & Humanities Open*, *4*(1), 100172. https://doi.org/10.1016/j.ssaho.2021.100172

Irmita, L., & Atun, S. (2018). The Influence of Technological Pedagogical and Content Knowledge (TPACK) Approach on Science Literacy and Social Skills. *Journal of Turkish Science Education.*, *15*(3), 27–40. https://doi.org/10.12973/tused.10235a

Irwanto, I., Redhana, I. W., & Wahono, B. (2022). Examining Perceptions of Technological Pedagogical Content Knowledge (Tpack): A Perspective

From Indonesian Pre-Service Teachers. *Jurnal Pendidikan IPA Indonesia*, *11*(1), 142–154. https://doi.org/10.15294/jpii.v11i1.32366

Janssen, N., & Lazonder, A. W. (2016). Support for technology integration: Implications from and for the TPACK framework. In *Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators: Second Edition*. https://doi.org/10.4324/9781315771328

Jihadul, F., & Widihastuti*, W. (2022). Development of Affective Self-Assessment Instrument of Chemistry for High School Student as the Daily Assessment Guideline. *European Journal of Educational Research*, *11*(1), 445–456. https://doi.org/10.12973/eu-jer.11.1.445

Jing, J. (2014). A critical review of Pedagogical Content Knowledge' components: Nature, principle and trend. *International Journal of Education and Research*, *2*(4), 411–424.

Joharmawan, R., Ibnu, S., & Fajaroh, F. (2021). *Turkish Journal of Computer and Mathematics Education Vol.12 No.9 (2021),1061-1069 Research Article*.

Karababa, A., & DiLmaç, B. (2015). Ergenlerde İnsani Değerlerin Sürekli Öfke ve Öfke İfade Biçimlerini Yordamadaki Rolü. *İlköğretim Online*, *14*(3). https://doi.org/10.17051/io.2015.85927

Karampelas, K. (2023). Examining the relationship between TPACK and STEAM through a bibliometric study. *European Journal of Science and Mathematics Education*, *11*(3), 488–498. https://doi.org/10.30935/scimath/12981

Karlström, M., & Hamza, K. (2019). Preservice Science Teachers' Opportunities for Learning Through Reflection When Planning a Microteaching Unit. *Journal of Science Teacher Education*, *30*(1), 44–62. https://doi.org/10.1080/1046560X.2018.1531345

Karlström, M., & Hamza, K. (2021). How Do We Teach Planning to Pre-service Teachers – A Tentative Model. *Journal of Science Teacher Education*, *32*(6), 664–685. https://doi.org/10.1080/1046560X.2021.1875163

Kartimi, Gloria, R. Y., & Anugrah, I. R. (2021). Chemistry online distance learning during the covid-19 outbreak: Do tpack and teachers' attitude matter? *Jurnal Pendidikan IPA Indonesia*, *10*(2), 228–240. https://doi.org/10.15294/jpii.v10i2.28468

Peraturan Menteri Pendidikan dan Kebudayaan Nomor 21 Tahun 2016 tentang Standar Isi Satuan Pendidikan Dasar dan Menengah, Pub. L. No. BN.2016/No.954, https://jdih.kemdikbud.go.id/: 4 hlm., 21 Permendikbud

(2016). https://repositori.kemdikbud.go.id/4791/1/Permendikbud_Tahun2016_Nomor021.pdf

Kim, S., Raza, M., & Seidman, E. (2019). Improving 21st-century teaching skills: The key to effective 21st-century learners. *Research in Comparative and International Education*, *14*(1), 99–117. https://doi.org/10.1177/1745499919829214

Kırılmazkaya, G., Keçeci, G., & Kırba, F. (2015). *Determination Of Preservice Science Teachers' Self Afficiency*. *3*(2).

Koehler, J. M., & Mishra, P. (2009). What is Technological Pedagogical Content Knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70. https://doi.org/10.1177/002205741319300303

Koehler, M. J., & Mishra, P. (2005). What Happens When Teachers Design Educational Technology? The Development of Technological Pedagogical Content Knowledge. *Journal of Educational Computing Research*, *32*(2), 131–152. https://doi.org/10.2190/0EW7-01WB-BKHL-QDYV

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers and Education*, *49*(3), 740–762. https://doi.org/10.1016/j.compedu.2005.11.012

Koehler, M. J., Punya, M., & Cain, W. (2013). What Is Technological Pedagogical Content Knowledge (TPACK)? *Journal of Education*, *193*(3), 13–19.

Koo, T. K., & Li, M. Y. (2016). A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. *Journal of Chiropractic Medicine*, *15*(2), 155–163. https://doi.org/10.1016/j.jcm.2016.02.012

Krauskopf, K., & Forssell, K. (2018). When knowing is believing: A multi-trait analysis of self-reported TPCK. *Journal of Computer Assisted Learning*, *34*(5), 482–491. https://doi.org/10.1111/jcal.12253

Lachner, A., Fabian, A., Franke, U., Preiß, J., Jacob, L., Führer, C., Küchler, U., Paravicini, W., Randler, C., & Thomas, P. (2021). Fostering pre-service teachers' technological pedagogical content knowledge (TPACK): A quasi-experimental field study. *Computers & Education*, *174*, 104304. https://doi.org/10.1016/j.compedu.2021.104304

Lehane, L., & Bertram, A. (2016). Getting to the CoRe of it: A review of a specific PCK conceptual lens in science educational research. *Educacion Quimica*, *27*, 52–58. http://dx.doi.org/10.1016/j.eq.2015.09.004

Levitan, B., Yee, C. L., Russo, L., Bayney, R., Thomas, A. P., & Klincewicz, S. L. (2008). A Model for Decision Support in Signal Triage: *Drug Safety*, *31*(9), 727–735. https://doi.org/10.2165/00002018-200831090-00001

Liunokas, S. M., Supiah, I., & Louise, Y. (2021). Chemistry Teacher ' s Perception About Their Technology , Pedagogical , and Content Knowledge. *Proceedings of the 6th International Seminar on Science Education (ISSE 2020)*, *541*(Isse 2020), 315–321.

Loughran, J., Berry, A., & Mulhall, P. (2012). *Understanding and Developing Science Teachers' Pedagogical Content Knowledge* (2. ed). Sense Publ.

Lyublinskaya, I., & Kaplon-schilis, A. (2022). Education sciences Analysis of Differences in the Levels of TPACK : Unpacking Performance Indicators in the TPACK Levels Rubric TPACK-framework-based. *Education Sciences*, *12*(79), 1–20.

Mårell-Olsson, E., & Broman, K. (2020). Holographic Learning—The use of augmented reality technology in chemistry teaching to develop students' spatial ability. *CEUR Workshop Proceedings*, *3046*.

Marifa, H. A., Abukari, M. A., Samari, J. A., Dorsah, P., & Abudu, F. (2023). Chemistry teachers' pedagogical content knowledge in teaching hybridization. *Pedagogical Research*, *8*(3), em0162. https://doi.org/10.29333/pr/13168

Martin, D. J. (1994). Concept mapping as an AID to lesson planning: A longitudinal study. *Journal of Elementary Science Education*, *6*(2), 11–30. https://doi.org/10.1007/BF03173755

Max, A. L., Lukas, S., & Weitzel, H. (2022). The relationship between self-assessment and performance in learning TPACK: Are self-assessments a good way to support preservice teachers' learning? *Journal of Computer Assisted Learning*, *38*(4), 1160–1172. https://doi.org/10.1111/jcal.12674

Maya, L., & Suseno, M. (2022). Investigating the Incorporation of Digital Literacy and 21st-Century Skills into Postgraduate Students' Learning Activities. *ELE Reviews: English Language Education Reviews*, *2*(1), 13–27. https://doi.org/10.22515/elereviews.v2i1.5121

Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record: The Voice of Scholarship in Education*, *108*(6), 1017–1054. https://doi.org/10.1177/016146810610800610

Mishra, P., & Koehler, M. J. (2008). Introducing Technological Pedagogical Content Knowledge. *Annual Meeting of the American Educational Reserach Association*, *3*(March), 1–16.

Naqvi, S. A. (2016). *Teaching Practice: Prevalent and Expected Performance Level of Prospective Teachers*. *May*.

Nasution, M. (2019). Kajian Tentang Hubungan Deret Volta dan Korosi Serta Penggunaannya Dalam Kehidupan Sehari-Hari. *Teknologi berkelanjutan berbasis industri 4.0*, 251–254.

Nsabayezu, E., Iyamuremye, A., Nahimana, J. P., Mukiza, J., Kampire, E., & Nsengimana, T. (2022). The progress in the application of rubric materials in chemistry teaching and students' learning enhancement during 21st century: A systematic review. *Discover Education*, *1*(1), 5. https://doi.org/10.1007/s44217-022-00005-y

Oberg, C. (2010). Guiding classroom instruction through performance assessment. *Journal of Case Studies in Accreditation and Assessment*, *1*(1), 1–12.

Oluwatayo, J. A., & Adebule, S. O. (2012). Assessment of teaching performance of student-teachers on teaching practice. *International Education Studies*, *5*(5), 109–115. https://doi.org/10.5539/ies.v5n5p109

Ozdilek, Z., & Robeck, E. (2019). Enabling Pre-service Chemistry Teachers' Development of Technological, Pedagogical, and Content Knowledge (TPACK) through Case-Based Lesson Planning. *Eğitim Fakültesi Dergisi 32*, *32*(1), 207–225. https://doi.org/10.19171/uefad.533233

Oztay, E. S., & Boz, Y. (2022). Interaction between pre-service chemistry teachers pedagogical content knowledge and content knowledge in electrochemistry. *Journal of Pedagogical Research*, *6*(1), 245–269. https://doi.org/10.33902/jpr.2022.165

Paristiowati, M., Yusmaniar, Fazar Nurhadi, M., & Imansari, A. (2020). Analysis of Technological Pedagogical and Content Knowledge (TPACK) of Prospective Chemistry Teachers through Lesson Study. *Journal of Physics: Conference Series*, *1521*(4), 042069. https://doi.org/10.1088/1742-6596/1521/4/042069

Permana, I. (2019). *Program Perkuliahan Orientasi Praktek Keguruan Dengan Pola Irvare Berbasis Beban Kognitif Untuk Meningkatkan Pedagogical Content Knowledge Ipa Terpadu Mahasiswa Calon Guru* [Disertasi, Universitas Pendidikan Indonesia]. http://repository.upi.edu/42311/

Putri, S. A., Sulaeman, N. F., & Putra, P. D. A. (2022). Trend of Technological Pedagogical Content Knowledge (TPACK) for Pre-service Science Teacher: A Historical Review. *Jurnal Pendidikan Fisika*, *10*(2), 165–175. https://doi.org/10.26618/jpf.v10i2.7801

Rap, S., Feldman-Maggor, Y., Aviran, E., Shvarts-Serebro, I., Easa, E., Yonai, E., Waldman, R., & Blonder, R. (2020). An Applied Research-Based Approach to Support Chemistry Teachers during the COVID-19 Pandemic. *Journal of Chemical Education*, *97*(9), 3278–3284. https://doi.org/10.1021/acs.jchemed.0c00687

Regis, A., Albertazzi, P. G., & Roletto, E. (1996). Concept Maps in Chemistry Education. *Journal of Chemical Education*, *73*(11), 1084. https://doi.org/10.1021/ed073p1084

Richey, R. C., & Klein, J. D. (2014). Design and Development Research. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of Research on Educational Communications and Technology* (pp. 141–150). Springer New York. https://doi.org/10.1007/978-1-4614-3185-5_12

Richey, R. C., Klein, J. D., & Nelson, W. A. (2004). *Developmental Research: Studies Of Instructional Design And Development*.

Sabdhosih, H., & Isnaeni, W. (2018). *Analysis of Implementation Plan of Science Learning and the Factors of Its Implementation in MTs and MA Al Khoiriyyah Semarang*.

Schmid, M., Brianza, E., & Petko, D. (2020). Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK.xs) and comparing the factor structure of an integrative and a transformative model. *Computers & Education*, *157*, 103967. https://doi.org/10.1016/j.compedu.2020.103967

Schmid, M., Brianza, E., & Petko, D. (2021). Computers in Human Behavior Self-reported technological pedagogical content knowledge ( TPACK ) of pre-service teachers in relation to digital technology use in lesson plans. *Computers in Human Behavior*, *115*(October 2020), 106586. https://doi.org/10.1016/j.chb.2020.106586

Schmidt, D. A., Baran, E., Thompson, A. D., Koehler, M. J., & Shin, T. S. (2009). Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149.

Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation Coefficients: Appropriate Use and Interpretation. *Anesthesia & Analgesia*, *126*(5), 1763–1768. https://doi.org/10.1213/ANE.0000000000002864

Schultz, M., Lawrie, G. A., Bailey, C. H., & Dargaville, B. L. (2018). Characterisation of teacher professional knowledge and skill through content representations from tertiary chemistry educators. *Chemistry Education Research and Practice*, *19*(2), 508–519. https://doi.org/10.1039/C7RP00251C

Şen, Ş. (2022). Modelling the relations between Turkish chemistry teachers' sense of efficacy and technological pedagogical content knowledge in context. *Interactive Learning Environments*, *30*(7), 1215–1228. https://doi.org/10.1080/10494820.2020.1712430

Shofwa, A., Endang, S., Budi, H., & Sri, Y. (2021). Prospective Chemistry Teacher's Pedagogical Content Knowledge in Chemical Application Planning. *Journal of Physics: Conference Series*, *1842*(1), 012076. https://doi.org/10.1088/1742-6596/1842/1/012076

Shulman, L. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, *15*(02), 4–14.

Soko, I. (2018). *Pendidikan dan Pelatihan Pembelajaran Fisika Yang Mengintegrasikan Budaya Nusa Tenggara Timur Untuk Meningkatkan Pedagogical Content Knowledge Guru Fisika* [Disertasi, Universitas Pendidikan Indonesia]. http://repository.upi.edu/48096/

Sri, Y., Mardhiyah, A. A., Mohammad, M., & Endang, S. (2021). Identification of Pedagogical Content Knowledge (PCK) for Prospective Chemistry Teachers: Efforts to Build Teachers' Professional Knowledge. *Journal of Physics: Conference Series*, *1842*(1), 012077. https://doi.org/10.1088/1742-6596/1842/1/012077

Sulaiman, J., & Ismail, S. N. (2020). Teacher competence and 21st century skills in transformation schools 2025 (TS25). *Universal Journal of Educational Research*, *8*(8), 3536–3544. https://doi.org/10.13189/ujer.2020.080829

Susilo, H., & Rohman, F. (2020). Teacher competency and perception in lesson planning using a software prototype. *International Journal of Innovation, Creativity and Change.*, *13*(September), 811–827.

Taber, K. S. (2018). The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

Temizhan, E., Mirtagioglu, H., & Mendes, M. (2022). *Which Correlation Coefficient Should Be Used for Investigating Relations between Quantitative Variables? 85*(1).

Thompson, A. D., & Mishra, P. (2007). *Editors ' Remarks ecom s ews: TP K CK ! 24*(2), 37–39.

Tracey, M. W. (2009). Design and development research: A model validation case. *Educational Technology Research and Development*, *57*(4), 553–571. https://doi.org/10.1007/s11423-007-9075-0

Tyarakanita, A. (2020). A Case Study of Pre-Service Teachers' Enabling TPACK Knowledge: Lesson Design Projects. *ELS Journal on Interdisciplinary Studies in Humanities*, *3*(2), 158–169. https://doi.org/10.34050/els-jish.v3i2.10006

von Kotzebue, L. (2022). Beliefs, Self-reported or Performance-Assessed TPACK: What Can Predict the Quality of Technology-Enhanced Biology Lesson Plans? *Journal of Science Education and Technology*, *31*(5), 570–582. https://doi.org/10.1007/s10956-022-09974-z

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & Van Braak, J. (2013). Technological pedagogical content knowledge - a review of the literature: Technological pedagogical content. *Journal of Computer Assisted Learning*, *29*(2), 109–121. https://doi.org/10.1111/j.1365-2729.2012.00487.x

Vošnjak, M., & Devetak, I. (2023). The context of science fiction in the pre-service teachers' chemistry education. *Chemistry Teacher International*, *0*(0). https://doi.org/10.1515/cti-2022-0029

Wahyu, S., Rizal, F., & Syah, N. (2021). Teacher Performance Analysis in the Learning Process. *Journal of Education Research and Evaluation*, *5*(1), 67. https://doi.org/10.23887/jere.v5i1.30758

Wan, Y., & Bi, H. (2016). Representation and Analysis of Chemistry Core Ideas in Science Education Standards between China and the United States.

*Journal of Chemical Education*, *93*(1), 70–78. https://doi.org/10.1021/ed500861g

Wang, Z., Adesope, O., Sundararajan, N., & Buckley, P. (2021). Effects of different concept map activities on chemistry learning. *Educational Psychology*, *41*(2), 245–260. https://doi.org/10.1080/01443410.2020.1749567

Wei, B., & Long, F. (2021). Teaching chemistry in context: What we know from teachers' lesson plans. *International Journal of Science Education*, *43*(8), 1208–1227. https://doi.org/10.1080/09500693.2021.1905906

Wilujeng, I., Tadeko, N., & Dwandaru, W. S. B. (2020). Website-Based Technological Pedagogical And Content Knowledge For Learning Preparation Of Science Teachers. *Jurnal Cakrawala Pendidikan*, *39*(3), 545–559. https://doi.org/10.21831/cp.v39i3.31228

Wren, D. G. (2009). *Performance Assessment: A Key Component Of A Balanced Assessment System*. Virginia Beach City Public School. Macmillan College Publishing Company.

Zamora, J. T., & Zamora, J. J. M. (2022). 21st Century Teaching Skills and Teaching Standards Competence Level of Teacher. *International Journal of Learning, Teaching and Educational Research*, *21*(5), 220–238. https://doi.org/10.26803/ijlter.21.5.12

Zhubi, A., & Ismajli, H. (2022). The Interconnection Between Technological, Pedagogical and Content Knowledge in Primary School Lesson Planning. *Journal of Social Studies Education Research*, *13*(2), 125–146.

Zimmermann, F., Melle, I., & Huwer, J. (2021). Developing Prospective Chemistry Teachers' TPACK–A Comparison between Students of Two Different Universities and Expertise Levels Regarding Their TPACK Self-Efficacy, Attitude, and Lesson Planning Competence. *Journal of Chemical Education*, *98*(6), 1863–1874. https://doi.org/10.1021/acs.jchemed.0c01296