12(2), 2023, 45-55 DOI: 10.23960/jppk.v12.i2.2023.05
Jurnal Pendidikan dan Pembelajaran Kimia
e-ISSN: 2714-9595| p-ISSN 2302-1772
http://jurnal.fkip.unila.ac.id/index.php/JPK/index

# Student Worksheet Oriented on Self-Regulated Learning (SRL) Strategy to Improve Student Learning Outcomes on Acid-Base Titration

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*Received: June 15th, 2023 Accepted: June 21st, 2023 Online Published: August 1st, 2023*

**Abstract: Student worksheet Oriented on SRL Strategy to Improve Student Learning Outcomes on Acid-Base Titration.** Acid-base titration is material in chemistry. One of the things to support students to learn acid-base titration material is the ability of self-regulation. This study aims to obtain student worksheet that can improve learning outcomes through self-regulation strategies. This research uses the Borg and Gall method R&D model with three stages, including the preliminary study stage, the media development and theoretical validity stage, and the media trial stage. The trial design is through one group pre-test post-test. The result of this study obtained a very valid category of ten indicators of content criteria, eight indicators of construct criteria and six indicators of presentation, the student worksheet practicality score obtained an average percentage of 98,29% with a very practical category and the student worksheet effectiveness score obtained a sig value (2-tailed) 0.000 analysed through a paired t-test. Therefore, it can be concluded that the student worksheet oriented on SRL strategy is declared feasible to use to improve students' learning outcomes.

**Keywords:** Student Worksheet, Self-Regulated Learning (SRL) Strategy, Student Learning Outcomes

***Abstrak: Kelayakan LKPD Berorientasi Strategi SRL untuk Meningkatkan Hasil Belajar Peserta Didik pada Materi Titrasi Asam Basa.*** *Titrasi asam basa merupakan materi dalam ilmu kimia. Salah satu hal untuk mendukung peserta didik mempelajari materi titrasi asam basa yaitu kemampuan regulasi diri. Penelitian ini bertujuan untuk memperoleh LKPD yang dapat meningkatkan hasil belajar melalui strategi regulasi diri. Penelitian ini menggunakan model R&D metode Borg and Gall dengan tiga tahapan, antara lain tahapan studi pendahuluan, tahapan pengembangan media dan validitas teoritis, dan tahapan uji coba media. Desain uji coba melalui one group pre-test post-test. Hasil penelitian ini memperoleh kategori sangat valid terhadap sepuluh indikator kriteria isi, delapan indikator kriteria konstruk, dan enam indikator presentasi, skor kepraktisan LKPD memperoleh persentase rata-rata 98,29% dengan kategori sangat praktis dan skor keefektifan LKPD memperoleh nilai sig (2-tailed) 0.000 dianalisis melalui uji-t berpasangan. Oleh sebab itu, dapat disimpulkan bahwa LKPD berorientasi strategi SRL dinyatakan layak digunakan untuk meningkatkan hasil belajar peserta didik.*

***Kata kunci:*** *Lembar Kerja Peserta Didik (LKPD), Strategi Self-Regulated Learning (SRL), Hasil Belajar Peserta Didik.*

## ▪ INTRODUCTION

Learning occurs because of the interaction process between teachers and students. The purpose of learning is to realize the effectiveness of activities carried out by students. One indicator of success in learning is when students obtain optimal learning outcomes through the selection of the right learning strategy or model, learning environment, and selection of learning tools that support learning.

Learning outcomes are the various skills of students after going through the learning process (Sudjana, 2006). The success of students on the material taught can be measured through the measurement of learning outcomes (Kunandar, 2013). The acquisition of student learning outcomes is still low. Data from the high school national exam results in 2017 showed an average score of 50.52 in chemistry. (Puspendik, 2017).

Low Self-Regulated Learning (SRL) regulation is one of the factors that result in low student learning outcomes, this is supported by the results of research by Fazriah (2019) showing a positive relationship between SRL and students' chemistry learning outcomes. SRL is the ability of learners to play an active role in their learning process (Zimmerman, 1989). According to Philip (2012) the steps of SRL consist of seven stages, among which are analyse; plan; implement; comprehend; problem solve; evaluate; and modify. SRL emphasizes the growth of self-motivation and self-efficacy that will be able to achieve the goals to be achieved. The SRL strategy can train students to obtain an affective learning style through the process of planning, implementing, monitoring learning progress to evaluating learning styles, where the results of learning style evaluation are used by students as consideration in planning the next learning style (Permatasari et al., 2017).

Pre-research results in class XI IPA 4 SMA Negeri 20 Surabaya showed that 65% of students did not use learning strategies in learning chemistry materials, and 68% of students did not want to ask for help from others when they had difficulty understanding chemistry materials (Schunk, 2011). Based on pre-research results, means that students' Self-Regulated Learning (SRL) is still relatively low.

One of the concepts taught to students about chemistry is acid-base titration. Based on pre-research results, data obtained by 38.23% of students considered acid-base titration as quite difficult chemical material and 50% considered acid-base titration as difficult chemical material. Acid-base titration material is considered difficult because of its abstract nature, students describe the neutralization process as chemical and physical mixing of acids and base that do not produce products and do not have reaction equations (Tri Astuti & Marzuki, 2018). Based on pre-research results that has been explained, the success of a learner to achieve learning objectives in learning chemistry can be determined one of them through self-regulation. There is positive correlation between students' self-regulation and chemistry learning outcomes (Fitriani, 2019).

The development of learning tools oriented to the SRL strategy is one of many way for educators to help smooth teaching activities, namely to improve student learning outcomes by training their freedom to achieve their learning goals. (Permatasari et al., 2017). One of the forms is student worksheets. Student worksheets are paper-based learning resources that contain assignments, instructions for working on problems, learning evaluations that are completed by students (Pawestri, 2020). In addition, there are also student worksheets in electronic form which consist of material summaries, questions for doing tasks containing text, audio and audio-visual elements (Awe & Ende, 2019).

The research on the development of SRL strategy-oriented student worksheet is in line with previous research entitled "Development and Modification of Learning Tools Based on Self-Regulated Learning for Environmental Accounting Materials to Improve Students' Cognitive Learning Outcomes". The research obtained an average N-Gain score for all students of 0.68 and a classical completeness of 100% which showed that SRL-based learning tools on environmental balance material and changes were feasible to be used to improve students' cognitive learning outcomes (Permatasari et al., 2017).

Based on the introduction, then the author has an interest in carrying out research with the title "Student worksheet Oriented on Self-Regulated Learning Strategy to Improve Student Learning Outcomes on Acid-Base Titration". The novelty of this study lies in the use of acid-base titration material in the development of worksheets for SRL strategy-oriented learners.

## ▪ METHOD

This development research used an R&D model that is guided by the Borg and Gall method. (Sugiyono, 2014). The development of this Self-Regulated Learning (SRL) strategy oriented student worksheet refers to Borg and Gall method adapted from (Sugiyono, 2014). This research and development consist of three stages, including initial study stage, media development and validation stage, and media trial stage.

### Research Subject

Research topics were provided by class XI MIPA 4 SMA Negeri 20 Surabaya with a total of 18 students. The selection of 18 students is due to the consideration that if less than 10 students, the data obtained does not describe the target population. However, if more than 20 students, the information obtained exceeds what is needed, resulting in less useful for analysing in small groups (S.Sadiman et al., 2018).

### Procedure

The initial study contained potential and problems. The initial study stage was carried out to obtain information about the potential and problems that students have in acid-base titration material. Low learning outcomes and student worksheets that only contain material and practice questions make this research possible.

The second stage is media development and theoretical validation which aims to develop student worksheets as learning media, then make improvements based on lecturers' suggestions and input, then validated by chemistry education lecturers and chemistry teachers to see the feasibility of SRL strategy-oriented student worksheets from the aspects of validity, practicality, and effectiveness.

The third stage is media trials. The media trial stage aims to see effectiveness of the developed product. Product development can be tested immediately after being revised by the validator. Media trials in this study were conducted with heterogeneously selected-students based on their academic ability level from previous material scores, namely six upper group students (good academic ability) six middle group students (sufficient academic ability), and six lower group students (poor academic ability).

**Research Instruments**

Research instruments were made to collect research data so that the feasibility of SRL strategy-oriented student worksheets developed was known. The research instruments used include 1) student worksheet validation sheet; 2) learner response questionnaire sheet; and 3) pretest and posttest questions. The validation sheet was used to determine the feasibility of SRL strategy-oriented learner worksheets through statements and assessment scores on content and construct validation. The student response questionnaire was designed to obtain a practical SRL strategy-oriented student worksheet. The pre-test and post-test questionnaires were used to obtain effective student worksheet.

**Data Collecting Methods**

Data collection methods were derived from observations, questionnaires, and test methods. The data collection method in this development research comes from observation using student activity observation sheets, questionnaires using student response questionnaire sheets, and test methods using pretest and posttest question sheets.

**Data Analysis Techniques**

The data analysis technique serves to obtain data that will be used as a basis for determining the feasibility of student worksheets oriented to the SRL strategy. Data analysis techniques used in this study are data analysis of validation results, analysis of students questionnaires, and data analysis of students learning outcomes.

Data analysis technique for the strategy-oriented validation sheet for student worksheet oriented on SRL strategy were performed by two validator from Surabaya State University chemistry education and one chemistry teacher of SMA Negeri 20 Surabaya including content, construct, and presentation validity. Validators give scores ranging from 1 to 5 according to the Likert scale in the table 1.

**Table 1.** Likert Scale Description

| Rating Category | Scale Value |
|---|---|
| Very Valid | 5 |
| Valid | 4 |
| Quite | 3 |
| Less Valid | 2 |
| Invalid | 1 |

(Riduwan, 2008)

The data from the validation results are ordinal data which can be analysed by determining the mode on each aspect or indicator with the following conditions: If the aspect assessed by the validator has a mode score $\geq 3$, then the aspect is declared valid, if the aspect assessed by the validator has a mode score $< 3$, then the aspect is declared invalid (Lutfi, 2021).

The practicality aspect of the student worksheet oriented on SRL strategy is obtained from the response questionnaire analysis technique. The learner response questionnaire is filled in with a checklist mark (√) using the Gutmann scale with the answer options “yes” and “no” which are presented in the table 2.

**Table 2.** Gutmann scale

| Answer | Positive answer score | Negative answer score |
|---|---|---|
| No | 0 | 1 |
| Yes | 1 | 0 |

Then, the following formula is used to calculate the results of the data that has been obtained

$$Practicality\ level = \frac{Score\ average}{Maximum\ score}\ x\ 100\%$$

Furthermore, The response questionnaire score criteria are interpreted through a table 3 based on the scores that have been obtained.

**Table 3.** Classification of Practicality Level

| Percentage (%) | Category |
|---|---|
| 81-100 | Very Practice |
| 61-80 | Practice |
| 41-60 | Enough Practice |
| 21-40 | Less Practice |
| 0-10 | Inpractice |

(Riduwan, 2008)

From table 3, the practicality of the student worksheets oriented on SRL strategy is said to be feasible if if they get a percentage score ≥ 61% (Riduwan, 2008).

Data analysis techniques on student learning outcomes were conducted with the aim of identifying improvements in student learning outcomes in the cognitive domain of students before and after the test. Data analysis techniques to measure the effectiveness of student worksheet as follows:

1) Normality Test

The normality test is a statistical test method that uses SPSS to determine whether or not the data is normally distributed. If the Sig value is greater than 0.05, the data is considered to be normally distributed; otherwise, it is considered to be non-normally distributed.

2) Paired Sample t-test

The t-test is used to see whether or not there is a significant difference in a sample.The t-test was conducted on the pretest data and posttest data in experimental class. The t test was conducted using SPSS with the following steps:

a) Proposed hypothesis:
   $H_0$ = There is no change between in average student learning outcomes before and after the test.
   $H_a$ = There is changes between in average student learning outcomes before and after the test.
b) Making conclusions
   If the value of (2-tailed) < 0.05, therefore $H_0$ is rejected
   If the value of (2-tailed) > 0.05, therefore $H_0$ is approved

(Lubis et al., 2017)

## ▪ RESULT AND DISCUSSION

At the preliminary study stage. Researchers conducted field observations to obtain potential and problem data. Based on the pre-research results by distributing questionnaires, it shows that the SRL data of students is still low. In addition, through the questionnaire, data were also obtained as much as 38.23% of students considered acid-base titration as quite difficult chemical material and 50% considered acid-base titration as difficult chemical material. The student worksheets used were the same as those on the market, and the student worksheets used contained only a overview of materials and questions that do not facilitate students to carry out practical activities to support knowledge in the chemistry learning process.

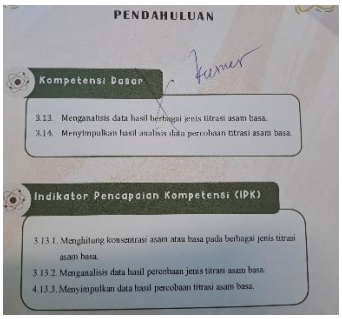
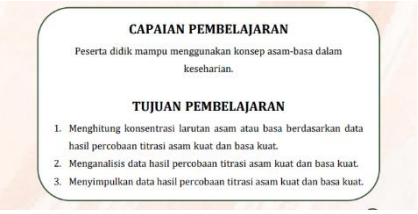
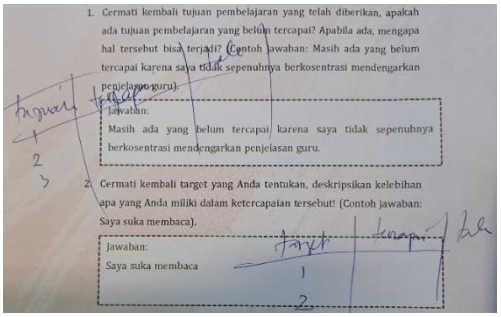
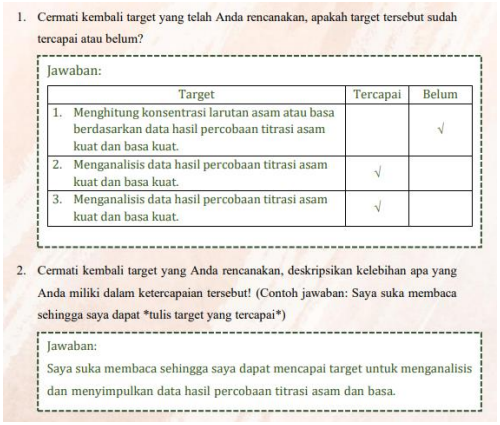
At the media development stage. Researchers started their activities from designing the cover, content, giving pictures, tables, practice questions, and other supporting information. This student worksheet is prepared in accordance with the steps of SRL strategy. According to Prastowo (2013) students worksheet are teaching materials in the form of sheets containing summaries, and instructions that must be completed by students. Its function is so that students can use student worksheets as a means that can increase activity, understand learning material, questions to practice, and help the learning process.

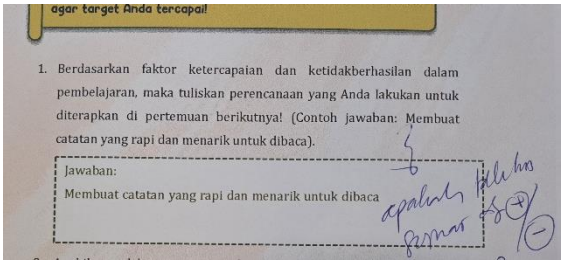
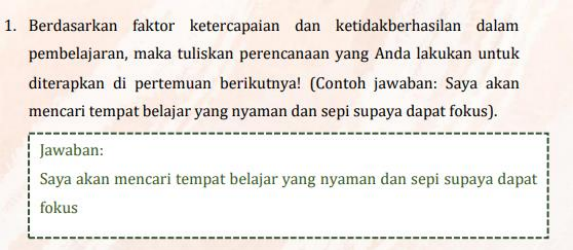
The process of making this student worksheet is assisted by the Microsoft Word application and the design uses the Canva application. The first stage is designing the student worksheet cover with and attractive colour combination. Researchers used the help of a color palette so that the color combination on the student worksheet could give a harmonious impression when viewed. This student worksheet has a colour combination on the cover design, namely yellow and green because it shows a bright impression, yellow symbolizes relaxation, knowledge, and optimism, while green symbolizes calmness and nature. The following is an image of the student worksheet cover.


**Figure 1.** Student Worksheet Design Cover

The design that has been made is then validated by chemistry education lecturers and chemistry teachers in order to obtain feedback for improving the development of SRL strategy-oriented student worksheet. After the researchers made revisions based on input and suggestions with the results in table 4.

**Table 4.** Results of SRL Strategy Oriented Student Worksheet Design Revision

| No | Suggestion | Revised Result |
|---|---|---|
| 1. | The curriculum used in the student worksheet oriented on SRL strategy was changed from Kurikulum 2013 revisi to the Kurikulum Merdeka Belajar. | **Before Revision**<br>  <br>PENDAHULUAN<br>Kompetensi Dasar<br>3.13. Menganalisis data hasil berbagai jenis titrasi asam basa.<br>3.14. Menyimpulkan hasil analisis data percobaan titrasi asam basa.<br>Indikator Pencapaian Kompetensi (IPK)<br>3.13.1. Menghitung konsentrasi asam atau basa pada berbagai jenis titrasi asam basa.<br>3.13.2. Menganalisis data hasil percobaan jenis titrasi asam basa.<br>4.13.3. Menyimpulkan data hasil percobaan titrasi asam basa.<br>**After revision**<br>  <br>CAPAIAN PEMBELAJARAN<br>Peserta didik mampu menggunakan konsep asam-basa dalam keseharian.<br>TUJUAN PEMBELAJARAN<br>1. Menghitung konsentrasi larutan asam atau basa berdasarkan data hasil percobaan titrasi asam kuat dan basa kuat.<br>2. Menganalisis data hasil percobaan titrasi asam kuat dan basa kuat.<br>3. Menyimpulkan data hasil percobaan titrasi asam kuat dan basa kuat. |
| 2. | The evaluation step of learning objectives is recommended to write in the form of a table. This makes it easier for learners to evaluate which goals have or have not been achieved. | **Before Revision**<br>  <br>1. Cermati kembali tujuan pembelajaran yang telah diberikan, apakah ada tujuan pembelajaran yang belum tercapai? Apabila ada, mengapa hal tersebut bisa terjadi? (Contoh jawaban: Masih ada yang belum tercapai karena saya tidak sepenuhnya berkosentrasi mendengarkan penjelasan guru).<br>Jawaban:<br>Masih ada yang belum tercapai karena saya tidak sepenuhnya berkosentrasi mendengarkan penjelasan guru.<br>2. Cermati kembali target yang Anda tentukan, deskripsikan kelebihan apa yang Anda miliki dalam ketercapaian tersebut! (Contoh jawaban: Saya suka membaca).<br>Jawaban:<br>Saya suka membaca<br>**After Revision**<br>  <br>1. Cermati kembali target yang telah Anda rencanakan, apakah target tersebut sudah tercapai atau belum?<br>Jawaban:<br>Target / Tercapai / Belum<br>1. Menghitung konsentrasi larutan asam atau basa berdasarkan data hasil percobaan titrasi asam kuat dan basa kuat. / / √<br>2. Menganalisis data hasil percobaan titrasi asam kuat dan basa kuat. / √ /<br>3. Menganalisis data hasil percobaan titrasi asam kuat dan basa kuat. / √ /<br>2. Cermati kembali target yang Anda rencanakan, deskripsikan kelebihan apa yang Anda miliki dalam ketercapaian tersebut! (Contoh jawaban: Saya suka membaca sehingga saya dapat *tulis target yang tercapai*)<br>Jawaban:<br>Saya suka membaca sehingga saya dapat mencapai target untuk menganalisis dan menyimpulkan data hasil percobaan titrasi asam dan basa. |

| No | Suggestion | Revised Result |
|---|---|---|
| 3. | The modification step should match the evaluation step on the deficiency aspect. | **Before Revision**<br>  <br>agar target Anda tercapai!<br>1. Berdasarkan faktor ketercapaian dan ketidakberhasilan dalam pembelajaran, maka tuliskan perencanaan yang Anda lakukan untuk diterapkan di pertemuan berikutnya! (Contoh jawaban: Membuat catatan yang rapi dan menarik untuk dibaca).<br>Jawaban:<br>Membuat catatan yang rapi dan menarik untuk dibaca<br>**After Revision**<br>  <br>1. Berdasarkan faktor ketercapaian dan ketidakberhasilan dalam pembelajaran, maka tuliskan perencanaan yang Anda lakukan untuk diterapkan di pertemuan berikutnya! (Contoh jawaban: Saya akan mencari tempat belajar yang nyaman dan sepi supaya dapat fokus).<br>Jawaban:<br>Saya akan mencari tempat belajar yang nyaman dan sepi supaya dapat fokus |

The next stage is theoretical validation. Learner worksheets based on content, organization, and presentation are used to determine the feasibility of validation results. Details of the validation results are described as follows.

**Table 5.** Student worksheet oriented on SRL strategy Validation Results

| No | Assessment Component | Mode | Criteria |
|---|---|---|---|
| 1. | Content Validity | 5 | Very valid |
| 2. | Construct Validity | 5 | Very valid |
| 3. | Presentation | 5 | Very valid |

From the table 5, The validation results obtained a score of 5 with a very valid category so it can be concluded that the SRL strategy-oriented student worksheet is feasible to use to improve student learning outcomes on acid-base titration material. The aspect of validity in accordance with the study by A'yunin & Dwiningsih (2022) obtained valid categories for all indicators.

The practicality aspect of the student worksheet is obtained from the data from the response questionnaire sheet to the SRL strategy obtained student worksheet distributed to students. The following results are obtained for the practicality aspect of the SRL strategy-oriented student worksheet.

**Table 6.** Response questionnaire results

| Rate Aspects | Percentage | Criteria |
|---|---|---|
| Student understanding of the material | 100% | Very Practice |
| Ease of use student worksheet | 94.44% | Very Practice |
| Presentation | 100% | Very Practice |

From the table 6, therefore it is concluded showing of student worksheets oriented on SRL strategies has a very practical category with an response questionnaire get a percentage between 94.44 – 100% with very practical criteria, it's meaning student worksheet is said to be practical if obtained is ≥ 61% (Riduwan, 2008). This is in line with research Purnamasari & Lutfi (2021) to obtain an increase in student enthusiasm for student worksheet obtaining a percentage of 99% with very practical criteria.

The effectiveness aspects obtained from the results of the before and after test scores of students at meetings 1 and 2. Limited product trial was conducted on eighteen students of class XI IPA 4. They learned acid-base titration material by being given the developed teaching materials, namely student worksheet oriented SRL strategy, obtained data on the results of classical completeness at meeting 1 of 72.22%, then obtained data on the results of classical completeness at meeting 2 of 100%, this shows an increase in student learning outcomes after being given teaching materials student worksheet oriented on SRL strategy. One of the characteristics of learners who have good SRL organization is that they know how to design, monitor, and direct mental processes to achieve and learning goals (Montalvo & Torres, 2004). This is in line with the underlying theory that the SRL strategy can train students to obtain an effective learning style through the process of planning, implementing, monitoring learning progress to evaluating learning styles, where the results of learning style evaluation are used by students as a consideration in planning the next learning style (Permatasari et al., 2017). Students were given a posttest consisting of 6 essay questions at the end of each meeting. After that, a normality test is carried out on the data that has been obtained to determine the distribution of the data population. Software assistance using SPSS 25 was used to conduct the normality test. The results of the normality test are presented in Figure 2.

**Tests of Normality**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| pretest | .178 | 18 | .135 | .911 | 18 | .088 |
| posttest1 | .176 | 18 | .146 | .935 | 18 | .239 |
| posttest2 | .217 | 18 | .025 | .847 | 18 | .008 |

**Figure 2.** Normality Test Results

From figure 2, therefore it is concluded showing that the data population is normally distributed with a significance value more than 0.05. Therefore, a parametric statistical test was conducted, namely the paired t-test. The paired t test results for post-test data from meetings 1 and 2 are as follows.

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | pretest - posttest1 | -32.08833 | 8.84843 | 2.08559 | -36.48855 | -27.68811 | -15.386 | 17 | .000 |

**Figure 3**. Posttest 1 t test Results

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | posttest1 - posttest2 | -15.74000 | 6.39035 | 1.50622 | -18.91785 | -12.56215 | -10.450 | 17 | .000 |

**Figure 4**. Posttest 2 t test Results

From on figures 3 and 4, the Sig (two-tailed) value is 0.000. Therefore it is concluded showing that student worksheets oriented on the SRL strategy are effective for improving student learning outcomes.

Based on the above discussion, the following points were obtained: Student worksheet oriented on SRL strategy was declared valid in terms of content, construct, and presentation validity. Student worksheet oriented on SRL strategy are declared practical in terms of student response questionnaires. Student worksheet oriented on SRL strategy were declared effective in terms of the pretest and posttest results. In the first and second meetings, there was significant difference between pretest and posttest through paired sample t-test.

## ▪ CONCLUSION

Self-regulation strategies can be one of the solution to improve student learning outcomes. Therefore, the researcher concluded that this student worksheet oriented on SRL strategy can improve students' learning outcomes on acid-base titration material.

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