

Exploring Revit Architecture Software -Aided Architectural Design

Author 1; Asst prof **Suchitra.Kondguli** University : KLE TECH University Hubli

Abstract

This study seeks to learn about students' Revit operating abilities at the novice level in curricular activities to meet the needs of the building sector. This study was carried out by fourth-year students KLETECH School of Architecture. The research method used was class action research, which was carried out in three cycles. This study seeks to learn about students' Revit operating abilities at the novice level conducted in three cycles. In the first cycle, the percentage of students who learned to master Revit Architecture was only 65% for Architecture, 55% for Annotate, and 75% for View. Students' achievement climbed to Architecture 89%, Annotate 75%, Massing & Site 80%, Solar Study 15 % and View 85% in the second cycle. During the third cycle, the proportion increased dramatically to 95% for Architecture, 88% for Annotate, 89% for Massing & Site, and 88% for View. During the third cycle, the percentages climbed significantly to Architecture 90%, Annotate 89%, Massing & Site 90%, Solar Study 65% and View 85%. In the second round, the average Revit score improved to 78% (competent quiet category). In the third cycle, the average score jumps to 89% (including the competent category). The study's findings proved the impact of Revit installation on entry-level proficiency. The findings of this study demonstrated the impact of Revit adoption on beginner-level proficiency for third-year students.

Keywords: Adoption of BIM, Architectural education readiness, Curriculum for BIM., construction industry, Revit Architecture

I. Introduction

All businesses are gradually transitioning to BIM technology. It is one of the most important labor market demands, impacting the principles of expert training in the construction industry and higher education institutions. To meet the needs of the business or industry world, excellent skill competencies, both soft and hard, are required. Students of Architecture are required to master many different types of architectural or civil applications, such as AutoCAD, SketchUp, Photoshop, Revit, Lumion, and other applications.

Technology advancements in the construction business are driving a shift in industrial firms. Most building design processes in the construction sector have adopted Building Information Modeling (BIM). BIM is an intelligent 3D model-based method that provides information and tools to architecture, engineering, and construction (AEC) professionals to more efficiently plan, design, construct, and manage buildings and infrastructure [1]. BIM has several advantages in construction work, such as helping project stakeholders understand what is to be created in a simulated environment to identify any potential design, construction, or operational difficulties.

Therefore, the KLETECH School of Architecture is curricular-based to support learning and to prepare students to participate in the Student Competency Sheet (LKS). The material for curricular activities learned in the Kletech School of Architecture is AutoCAD and SketchUp, while in the construction industry, the BIM software has been adapted recently. Based on the description above, to be able to meet the needs of the construction industry, implemented BIM software, namely the Revit application in curricular activities.

II. Methodology

This study employs the classroom action research method. A spiral is used in the research design. Cycle I, Cycle -II, and Cycle III

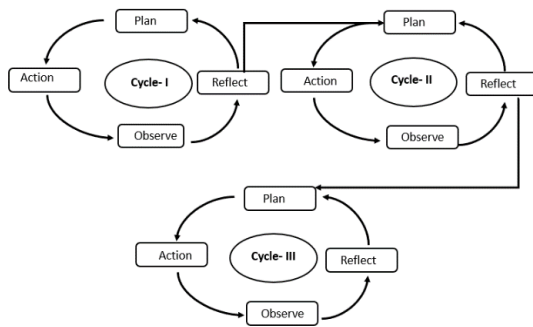


Figure 1: Kemmis and Mc Tanggart's model for classroom action research

The sample size was 35 students from 3rd year of the School of Architecture. Discussions, observation of teacher activity, observation of student activity, thought of student learning results Revit mastery assessments of students, and authenticating of student work were utilized to collect data.

This study's data analysis methodologies included descriptive qualitative and quantitative analysis. The percentage of student activity, teacher activity, and student learning outcomes using descriptive qualitative observation sheets is calculated. The analysis employed is scoring the percentage of Revit feature usage and n-gain for improving student learning outcomes.

Result and Discussion

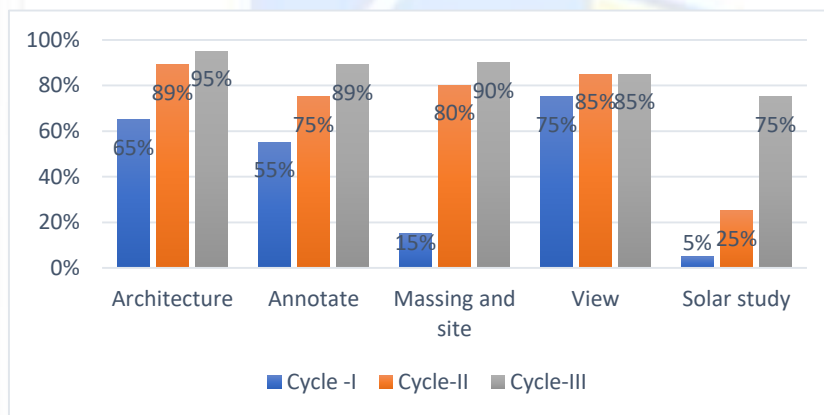


Figure 2: The percentage of students who mastered the Revit Architecture feature (Source: Personal Analysis, 2022)



Figure 3 Floor generated in Revit with grids, columns, Floor, Door

Revit features taught in Cycle I include Grid, Column, Wall, Floor, Door, Window, Ceiling, Circulation (Stairs), and Roof. This functionality is used to create floor layouts 1 and 2. The first cycle's average percentage has reached 85% with a competent category, indicating that students have mastered Architecture features such as Grid, Column, Wall, Floor, Door, Window, Ceiling, Circulation (Stairs), and Roof. However, 14 students did not meet the KKM in the first cycle of this Architecture feature because they had not entered parametric data in the modelling of building elements.

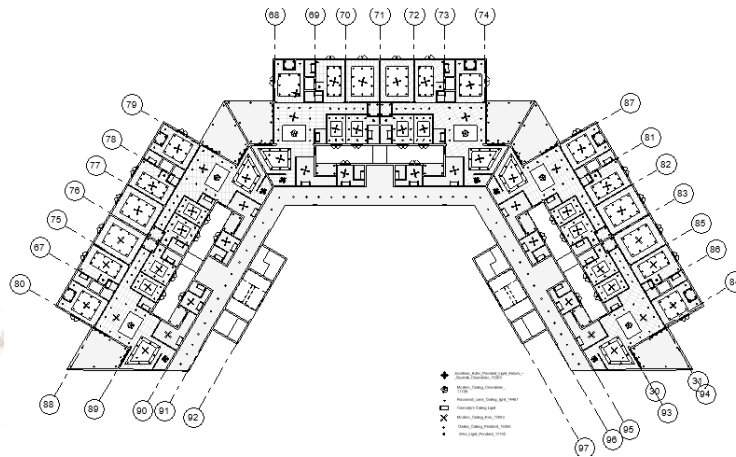


Figure 4: Reflected Ceiling Plan

2.1 Architecture Characteristics

The Architecture Revit features taught in Cycle I include Grid, Column, Wall, Floor, Door, Window, Ceiling, Circulation (Stairs), and Roof. This functionality is used to create floor layouts 1 and 2. The first cycle's average percentage has reached 85% with a competent category, indicating that students have mastered Architecture features such as Grid, Column, Wall, Floor, Door, Window, Ceiling, Circulation (Stairs), and Roof. However, 15 students did not meet the KKM in the first cycle of this Architecture feature because they had not entered parametric data in the modelling of building elements.

Students' grasp of the Architecture Revit feature grew by 0.45 in cycle II, with the category of modest improvement. Cycle II students have mastered the following Architecture features: Grid, Column, Wall, Floor, Door, Window, Ceiling, Circulation (Stairs), and Roof, with an average proportion of 90% with a competent category. Only two students in this second cycle have not yet met the KKM.

Students' understanding of the Architecture Revit feature did not improve considerably in cycle III, with the average percentage remaining at 90% the same as in cycle II. This is because in cycle II, all toolbar / Architecture features are: Grid, Column, Wall, Floor, Door, Window, Ceiling, Circulation (Stairs), and Roof. Students input all parametric data accurately and all students met the KKM of 86. The only rise in the Architecture Revit feature is 0.08 for Ceiling, Floor, Railing, and Stair, therefore there was no major growth in the second cycle.

2.2 Annotate features

Dimension, Text, and Tag are the annotated Revit features taught in Cycle I. This feature displays information on floor plans, looks, and items. The average percentage achieved in the first cycle is 55%, with the group of not-yet-competent students indicating that they have not grasped the material. Annotate Revit elements such as Dimension, Text, and Tags. This is because during the first cycle, was only given information on the first and second-story floor plan worksheets. In the initial cycle, because students did not provide complete information, no students met the KKM value.

In cycle II, students' mastery of the Annotate Revit features, including Dimension, Text, and Tags, increased by 0.02 with a low increase category. The average proportion of second-cycle students is only 80%, with the category of not competent indicating that students in the second cycle have not mastered the Annotate Revit capabilities, notably Dimension, Text, and Tags. In cycle III, students' knowledge of Annotate Revit features, namely Dimension, Text, and Tag, increased by 0.70 with the category of height growth and an average percentage, namely 85% with the category quite competent. This signifies that students have mastered the

Dimension, Text, and Tag elements of Annotate Revit. However, there are still 8 pupils who have not reached the KKM threshold, whereas the remaining 30 students have. Even though pupils have reached the KKM value and provided information on each worksheet about floor layout, looks, and parts. However, it does not adhere to the completely integrated BIM principle (system keynote editing, material keynote, elements, and so on)

2.3 Massing and site features

Site Component is the material taught in Cycle I about Massing and Site Features. This function is used to insert trees into the worksheet. However, there was no Family Revit on each student's PC during the first cycle due to an issue. As a result, students in the first cycle have not mastered the Massing and Site features.

The student's mastery of the Massing and site characteristics increased significantly in cycle II: Site Component experienced a large rise of 0.89 with a high increase category. The average percentage of this second cycle has reached 85% in the category of competence, indicating that students are already quite familiar with the Massing and site features, namely: Site Component, in the second cycle. In this second cycle, all students have completed the KKM.

Students' mastery of the Massing and site features, specifically the Site Component, did not improve in cycle III, with the average percentage remaining the same as in cycle II at 89%. This is because, in cycle II, all toolbars, massing, and site features are: Site Component, students have submitted all data in line with the essential job sheet, and students have reached KKM in the previous cycle.

2.4 Solar study

In cycle- Solar studies are used to visualize the sun's path and shadow cast by a structure or building at a specific period. The average percentage of the first cycle has only reached 30% with the category of not competent meaning students have not mastered the solar study, namely: setting the location,

This is because the solar study is not featured and has not been explained in cycle I. In this cycle-I, all students have not yet reached the KKM value.

Student's mastery of View Revit features such as setting the sun path, and solar study increased by 0.03 in cycle II, with a solar study average percentage of 43%.

Students' mastery of the View Revit function solar study, sunsetting, and Audiovisual play of sunrise to sunset increased by 0.75% in cycle III. The average percentage of this cycle III with the competent category has reached 85%, demonstrating that pupils have mastered the. In this third cycle, 0.75% of up to 10 students have yet to accomplish the KKM mark in solar study, sunsetting, and audiovisual play from dawn to sunset. Students could generate graphic videos or still images by using the sun tool and the sun setting toolbox, individually or in combination, to construct sun studies as desired. Many modes, such as still, single day, multiple day, and lighting, are offered for examining solar studies within a conceptual design environment and the project climate. The solar analysis is performed to determine how the shade from the terrain and its surrounding models impacts the site. We've also noticed the area where light can penetrate the structure at any time of day

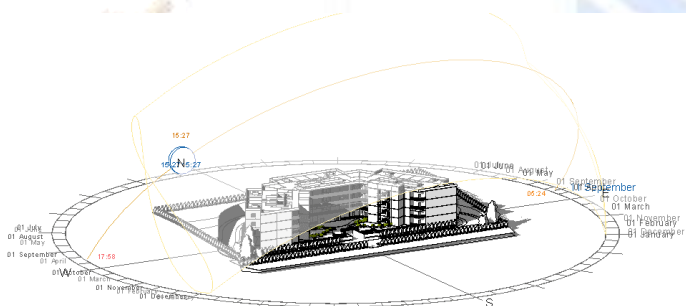


Figure 6: Interior View for Solar Study



Figure 5: Sun path study

2.5 View features

In cycle, I, the material taught about the View Revit features are: Create, and Sheet Composition, schedules, and quantities. These features are used to create pieces, view plans, views, pieces, 3D, schedules, and quantities. And can make title blocks or header images. The average percentage of the first cycle has only reached 42% with the category of not competent meaning students have not mastered the View Revit features, namely: Create, and Sheet Composition. This is because the toolbar / Sheet Composition feature has not been explained in cycle I. And in this cycle, I all students have not yet reached the KKM value.

Students' mastery of View Revit features such as Create and Sheet Composition rose by 0.02 in cycle II, with schedules and quantities: low increase category and an average percentage of 43%.

In cycle III, students' mastery of the View Revit functions, namely Create, Sheet Composition, and Schedules and Quantities, increased by 0.75 with a high increase category. The average percentage of this cycle III has reached 85% with the competent category, indicating that students have mastered the View Revit features, namely: Create and Sheet Composition. In this third cycle, as many as ten pupils have yet to achieve the KKM mark.

Figure 7: Schedule and quantities

The tool used to measure students' learning abilities in implementing Revit to meet the needs of the construction industry, specifically in the application of BIM, is the Individual Revit Competency Matrix taken from the Autodesk Revit Forum and has been through the face validity expert judgment type validation by Design Lecturer and Educator Subject; consequently, be appropriately considered for assessing student work documentation.

According to the Revit mastery calculation results, students have mastered various indicators on the Individual Revit Competency Matrix, specifically Level 3D. The 3D Level work indicators on the Individual Revit Individual Competency research are listed below, namely

View with signs that students must obtain, namely: Make New Plans, Drafting, and 3D Views

Create and modify levels

- I. Create new plans, drafts, and 3D views.
- II. Create and modify levels
- III. Collations, Elevations, Sections, and Details can be created and modified.
- IV. Enter and change Sheets, as well as Views.
- V. Print and arrange the sheets

The proportion of accomplishments attained by students at the 3D Level has only reached 86%, although the value that students must find to reach the 3D Level is 88%. This is because, in the Apartment Floor assignment, students only need to create plans, views, and parts and are not required to create Callouts Details

Elements and families with indicators that students must meet, namely:

- Create and alter grids
- Change and insert Walls, Doors, Windows, and Components.
- Edit kinds, insert and alter Curtain Wall

The percentage of achievement attained by students at the 3D Level, in modelling, was 60%, while the required percentage of achievement at the 3D Level is 85%. This is because the indicator changed the Family parameters to generate a new type. Students are not educated to develop new sorts of Families; rather, they are instructed to use Families that are already within the family library.

3.5.1 Modeling with symbols that students must achieve, namely:

- Edit types, insert and alter the roof, the ceiling, and the floor
- Change and insert Ramps, Stairs, and Railings.
- Apply the materials to all the architectural elements

The proportion of Level 3D successes on modelling work completed by 90%, the value has exceeded the value that students must reach at Level 3D by 85%. This is because, in their modelling work with each indicator, students have worked on each indicator by entering the correct parametric data.

3.5.2 Documentation containing student achievement indicators, such as:

- Create and alter Rooms, Room Tags, and Room Separation
- 3D views
- Door tags and window tags
- Insert and change detailed features such as Detail Lines, Filled Regions, and Masking Regions
- Schedule and quantities
- Enter and modify dimensions and text



Figure 8: Sheet Composition with rendering views

The proportion of achievements attained by students at the 3D Level in Documentation is 30%, whereas the value that students at the 3D Level must reach is 88%. This is because students did not install a text system in their Apartment Floor assignment. Drawing lines that are fully integrated with indicators following the BIM establishing and changing rooms, room tags, room separations, door tags, window tags, schedules, and quantities including changing detailed features such as detail lines, filled regions, and masking areas in the assignment.

Coordination. The outcomes of students' Revit mastery have reached the novice level / 3D or have met the required KKM value. This KKM value is a value that students must agree on for each indicator of the assignment topic. Although pupils have reached the beginner level, mastery of BIM software is required based on maturity level, namely 3D, 4D, 5D, 6D, and 7D. BIM manager, BIM engineer, BIM coordinator, BIM technician, architect, mechanical, electrical, and plumbing (MEP) BIM engineer, BIM project manager, BIM designer, BIM MEP designer, and BIM MEP designer are all connected to the sort of BIM work required by the construction sector. Furthermore, based on reviews of assignments with expertise in Architecture & Engineering students can fill positions as CAD / BIM compilers in the construction world, which is more expected in project management or construction management. Mastery of Revit at the beginner / 3D level has satisfied the building sector. However, additional time is required for studying services (MEP) if you want to reach the level of project management or 4D-7D.

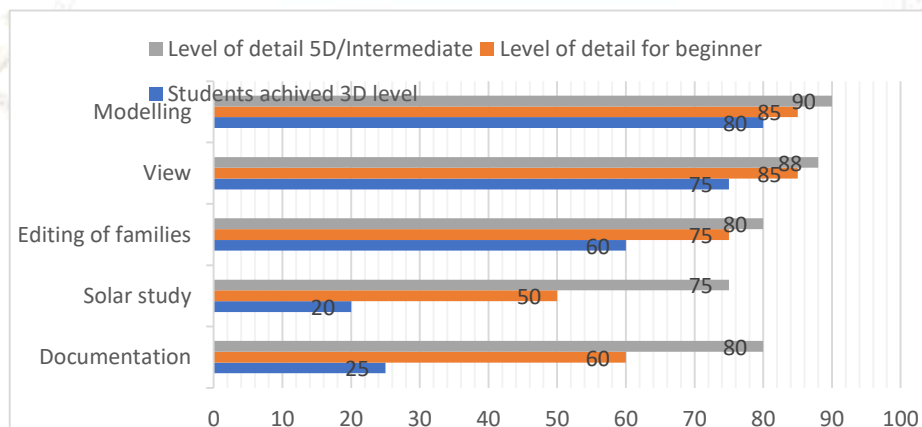


Figure 9: The percentage of students who mastered the Revit Architecture feature (Source: Personal Analysis, 2020)

Conclusion

The conclusions obtained from this study will help the students to understand

- The introduction of Revit Building Information Modelling (BIM) in the curriculum has met student competency demands at the learner or 3D level.
- Implementation of Building Information Modelling (BIM) Revit based on first cycle observations 92% of teachers explained learning well and directed students extremely well. And, while the teacher's involvement increased to 95% in cycle II and 100% in cycle III, it stayed in the good category in each cycle. Furthermore, in the first cycle, student involvement increased by 85% with an excellent category. And in the second cycle, it grew by 15%, reaching 90% with an excellent category. And in the third cycle, they climbed by 12% to 95% with a very good category.
- Implementation of Revit Building Information Modelling (BIM) in circular, as determined by the results of mastery of the Revit application, in cycle I with the material that explains how to make grids, columns, walls, floors, ceilings, doors, windows, stairs, and roof coverings, the average student receives a score of 50%, with the highest value of 68% and the lowest value of 40%. The completeness of learning in this first cycle is 10%, because when working on library and family assignments on Revit, it is not fully installed, resulting in student assignments that are unfinished as they have not entered parametric data on each element of the building. In the second cycle, the gain score of learning completeness increased by 0.45 in the medium category, with an average value of 5 out of 35 pupils. Mastery learning in this cycle II is 0%, which is related to the fact that the work on the Family Roofing and rendering assignment. Cycle II has the greatest value of 85% and the lowest value of 72%. There was a large rise in learning completeness by 100% in cycle III, with an average score of 90%. Cycle III had the greatest score of 95% and the lowest value of 84%. Increased by 0.53 from cycle II to cycle III.

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Implementation of Building Information Modelling (BIM) Revit to meet the needs of the construction industry

Building Information Modelling (BIM) Adoption Model for Architectural Education Ilya Fadjar Maharika¹, Achmad Irsan², Syarifah Ismailiyah Al Athas³, Ariadi Susanto⁴, Vendie Abma⁵, Yebi Yuriandala⁶

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