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*Article*

# Advancing Building and Construction Higher Education: The Online Real-Time Block Model's Impact on Professional Skills, Gender Equity, and Industry Relevance

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**Abstract:** Traditional In-Person Semester-Length (IP-SL) courses often struggle with inherent time constraints, lack of flexibility, and geographic limitations, which collectively delay effective learning and accessibility for students. Moreover, the extended duration of the Semester-Length (SL) structure may lead to decreased student focus due to lengthy engagement with multiple subjects simultaneously, increased stress levels, and limited opportunities for timely feedback and assessment. This study evaluates the Online Real-Time Block Model (ORT-BM) as a solution to these issues, focusing on its ability to enhance gender equity and industry relevance while addressing the building industry's demand for a skilled and diverse workforce. Building surveying professionals must stay current with rapidly evolving building codes, regulations, and sustainability practices; however, the rigid structure of IP-SL courses often hinders this, resulting in graduates being less prepared to meet industry needs. Conducting a comparative analysis of a case study: the Bachelor of Building Surveying program at an Australian higher education institution, the research compares three teaching models: IP-SL (2016–2018), In-Person Block Model (IP-BM, 2019–2020), and ORT-BM (2020–2023) using Student Evaluation of Units (SEU) data. The findings indicate that ORT-BM significantly improves student satisfaction, supports gender equity by providing flexible learning options, and enhances accessibility. Furthermore, SEU results quantitatively demonstrate that ORT-BM's innovative strategies and utilization of digital tools have the potential to align building and construction education with rapidly evolving industry standards while addressing gender imbalances. Future research may explore developing hybrid models to optimize cognitive load further, improve accessibility, and enhance flexibility.

**Keywords:** Building Surveying Education; Construction Higher Education; Digital Learning in Construction; Gender Equity in Construction; Intensive Online Teaching; Student Engagement

## 1. Introduction

In-Person (IP) Semester-length (SL) education is the most common method in higher education but faces limitations such as logistical constraints, inflexibility, and challenges during unexpected disruptions like lockdowns [1–3], which cause stress and time management difficulties among learners, affecting their focus [4,5]. These limitations are especially pronounced in male-dominated fields like construction, where traditional learning models can unintentionally reinforce gender disparities by limiting access for students who may face greater challenges balancing personal and professional responsibilities [6–8]. This is particularly relevant for women, who remain underrepresented in the building and construction industry [9–13]. Moreover, the construction

industry is experiencing rapid advancements in technology, sustainability practices, and regulatory requirements [14,15]. As a result, educational programs must adapt to ensure that graduates possess the professional skills to meet industry standards and remain competitive, particularly in fields like Building Surveying with a focus on updated regulations.

To address these challenges, researchers have investigated digital solutions like online, blended, and virtual collaborative learning [16,17]. Asynchronous (e.g., pre-recording lectures) and synchronous methods, e.g., live online lectures or Online Real-Time (ORT), have been introduced as alternatives to the IP method [18]. Despite the growing adoption of block models and online learning, there is a lack of comprehensive evaluation of their combined effects on student outcomes, particularly in professional programs like Building Surveying. These alternatives can improve flexibility, learning quality, and student engagement [19], although challenges like technical issues, accessibility concerns, and assessment integrity continue in online content delivery [20,21]. The intensive learning and teaching approach, known as the Block Model (BM), has emerged as an alternative to the SL approach in higher education and tertiary institution settings [22–24]. This approach offers an engaging learning experience that accelerates course completion and boosts engagement across diverse student demographics, including first-year and disadvantaged students [25,26]. Although BM demonstrates significant potential in enhancing educational outcomes [27], research on integrating BM with online educational methods remains limited, requiring further investigation into their combined efficacy.

In response to this gap, this paper introduces the Online Real-Time Block Model (ORT-BM), which combines online and intensive delivery methods, and evaluates its impact on teaching and learning environments, gender equity, engagement, and course progression. This research is crucial for informing educational practices in higher education, especially in fields requiring practical, regulatory knowledge like Building Surveying. By understanding the impact of the ORT-BM, institutions can make informed decisions about implementing more effective, accessible, and equitable educational strategies. The focus is on the Bachelor of Building Surveying (NBBS) course at Victoria University, comparing it with two other delivery methods: In-Person Semester-length (IP-SL) and In-Person Block Model (IP-BM), used for the same content and institution. This article comprises six sections. After this introduction, Section 2 reviews the relevant literature, then Section 3 explains the utilized methodology. The case study course and selected units are defined in Section 4. Section 5 presents the results of this study and provides a discussion. Then, the limitations of this study and suggested future topics are introduced in Section 6. Finally, Section 7 draws conclusions based on results and findings.

## 2. Literature Review

This section addresses two main concerns with traditional IP-SL delivery and reviews existing research on the impacts of online learning and intensive teaching. It evaluates the literature on integrating these methods to identify the effects of developed models and knowledge gaps.

The integration of online learning in higher education has transformed the field, particularly post-COVID-19 [28–30]. This shift, characterized by electronic communication, has encouraged researchers to investigate the applications of technology and digitalization in education [31–33]. Literature highlights challenges in adapting to new digital technologies and pedagogies, as well as opportunities to enhance student engagement [34,35]. Two main types of online delivery have been studied: asynchronous (pre-recorded lectures) and synchronous, live online lectures or ORT [36].

Asynchronous and synchronous modes offer benefits like flexibility, improved learning quality, student satisfaction, and increased enrolment [37–40]. However, challenges remain in delivering lab-based content online and managing cognitive load [36,41]. Despite these concerns, both modes are effective in flipped classrooms, collaborative learning, and problem-based learning [40,42–45]. Asynchronous lectures provide flexibility and accessibility, while synchronous lectures enhance interactivity and peer-centered activities, offering diverse advantages depending on the learning context [46–48].

Cognitive Load Theory (CLT) further underscores the importance of designing education models that balance cognitive demands with learner capacity [49,50]. Integrating intensive delivery methods like BM with online strategies has been shown to improve cognitive retention by structuring content into manageable blocks and supporting diverse student demographics, including disadvantaged learners [51]. However, accessibility challenges persist, particularly for students in regional areas or those with limited access to technology, emphasizing the need for institutional support and hybrid strategies [52,53]. Recent innovations, such as virtual reality and AI tools [54,55], offer additional opportunities to enhance ORT-BM's effectiveness by simulating practical, industry-relevant scenarios.

The literature emphasizes that both pre-recorded lectures and ORT have been successful in distance learning [46,56], with ORT being particularly beneficial for students with disabilities due to the interaction possibilities between students and instructors [57–59]. In contrast, ORT methods may result in a lower cognitive load for students [36], highlighting the need for innovative strategies that consider course content, learning outcomes, teaching modes, and student demographics [60–62]. Therefore, designing ORT curricula based on these factors and analyzing learner experiences through case studies can contribute to a more learner-centered environment.

The intensive learning and teaching approach, also known as the BM [63,64], immersive scheduling [24,65], or intensive delivery mode [66], has been implemented in various education settings [22,23,67–71], and proven effective, particularly for first-year undergraduates, repeating students, and those from disadvantaged backgrounds [64,72–76]. By condensing content into shorter, focused learning periods, BM enhances engagement, retention, and accessibility [77,78]. Furthermore, its integration with flexible learning models like the ORT-BM has the capability to address systemic barriers in male-dominated fields like construction. Gender equity can considerably benefit from such models, as they provide flexible learning schedules that reduce barriers to participation, particularly for women balancing professional and personal responsibilities [79]. At the same time, the building and construction industry, characterized by rapidly evolving standards, sustainability practices, and regulatory requirements, requires graduates equipped with up-to-date, industry-relevant skills [14,15]. Traditional learning models often fall short of meeting these demands, highlighting the need for innovative curriculum designs. Previous findings confirm BM's effectiveness in improving learning and teaching quality [70,80,81], suggesting that integrating BM with digital and flexible delivery strategies like ORT-BM could address these gaps while advancing inclusivity and preparing students for the challenges of a modern workforce.

Integrating ORT with BM can be a promising development in educational strategies, combining the strengths of both methods, flexibility and accessibility of ORT, engagement, and accelerated completion of BM, while mitigating their limitations. This article examines this integration's performance through a qualitative study on the NBBS course at Victoria University, Melbourne, and highlights how combining ORT and BM enhances educational outcomes and student engagement compared with IP-SL and IP-BM.

### 3. Methodology

This study employs a case study approach to examine the NBBS program at Victoria University over seven years, analyzing course reviews, monitoring data, and Student Evaluation of the Unit (SEU) feedback to assess instructional methodologies. SEU data was selected due to its comprehensive and consistent collection, providing reliable measures of student engagement, satisfaction, and teaching quality across all instructional models. Ethics approval (ID: HRE23-125) from Victoria University ensured compliance with ethical standards and safeguarded the anonymity of student feedback.

The NBBS program is a part of Victoria University's Senior College, with first-year students enrolled in the First Year College (FYC) model, introduced in 2018 [82,83]. Four units within this program, two second and two third-year units, were selected as case studies for their representativeness of core competencies in building surveying education. These units were delivered using three instructional methods: IP-SL (2016–2018), IP-BM (2019–2020), and ORT-BM (2020–2023).



Descriptive statistics were used to analyze SEU feedback, with averages and variances calculated to compare trends in student engagement, satisfaction, and teaching quality.

Potential methodological limitations include reliance on SEU data, which primarily captures quantitative feedback and may not fully reflect qualitative aspects of the student experience. Moreover, external factors such as the COVID-19 pandemic and changes in student demographics may have influenced the findings. To mitigate these limitations, data was cross-referenced with course monitoring reports to validate trends.

4. Case Study

This section introduces the NBBS course (Section 4.1) and four selected units (Section 4.2).

4.1. Bachelor of Building Surveying (NBBS) Course

The NBBS is a 3-year full-time course established in 2016 after separating from the Construction Management program. Accredited by the Victorian Building Authority (VBA), it meets the knowledge requirements for registration as an Unlimited Building Surveyor in Victoria [84]. The course transitioned from a traditional IP-SL to an intensive IP-BM in 2019, and then to the ORT-BM.

4.2. Selected Units of Subject

Four central units in the NBBS course are discussed: three specific subjects to NBBS and one (NBC3001) shared with the Bachelor of Construction Management and Bachelor of Building Design. These units were delivered in three modes: (1) IP-SL (2016-2018), (2) IP-BM (2019-2020), and (3) ORT-BM (2020-2023).

4.2.1. Building Regulations (NBC2002)

NBC2002 Building Regulations is a foundational unit for second-year students, providing an understanding of the National Construction Code (NCC) of Australia and related regulations for low-rise buildings. This unit transitioned from IP-SL to IP-BM in 2019 and adapted to ORT-BM in 2020 during the COVID-19 lockdown. Post-2022 reopening, NBC2002 became available in both IP-BM and ORT-BM formats. Table 1 provides a summarized overview of these transitions [85].

Table 1. The main changes in delivery, assessments, and key contents of NBC2002.

| Time Range | Delivery                                                 | Key Contents                                                           |
|------------|----------------------------------------------------------|------------------------------------------------------------------------|
| 2018-2019  | IP-SL: 12 weeks                                          | Understand and interpret the Building Code of Australia, Volume One    |
|            | One-hour lecture per week                                | Basics of Performance-Based Legislation                                |
|            | Two hours of tutorials per week                          | Understand Australia Standards                                         |
| 2019-2020  | IP-BM: Four-week block (11 sessions)                     | Interpretation of the NCC Heritage Requirements knowledge.             |
|            | Three intensive sessions (lectures & tutorials) per week | Enforcement, compliance provisions, and related procedures.            |
|            |                                                          | Introduction to Disability Discrimination Act (DDA) and accessibility. |
|            |                                                          | Fundamentals of Site Inspection and effective communication.           |

|            |                                                           |                           |
|------------|-----------------------------------------------------------|---------------------------|
| After 2020 | ORT-BM: Four-week block (11 sessions) under NBBS          | Same as from 2019 to 2020 |
|            | Three intensive sessions (lectures & tutorials) per week. |                           |

4.2.2. Performance-based Solutions for Buildings (NBC2109)

NBC 2109 is a core unit for second-year NBBS students, focusing on performance-based solutions through building code reviews and implementation procedures [86]. Performance-based codes offer flexibility in meeting performance requirements, crucial for building surveyors and certifiers [87]. Therefore, educators prioritize this unit as a key topic.

NBC 2109 was offered under the conventional IP-SL approach until it transitioned to IP-BM in 2019 and ORT-BM in 2020. Table 2 summarizes these changes.

**Table 2.** The main changes in delivery, assessments, and key contents of NBC2109.

| Time Range | Delivery                                                                                                      | Key Contents                                                                                                 |
|------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| 2016-2018  | IP-SL: 12 weeks                                                                                               | Introduction to Performance-Based Solutions for Buildings                                                    |
|            | One-hour lecture per week                                                                                     | Language & assessment methods for performance-based code                                                     |
|            | Two hours of tutorials per week                                                                               | Steps to developing performance solutions.<br>Performance-based code Part J<br>Performance-based code Part B |
| 2019-2020  | IP-BM: Four-week block (11 sessions)<br>Three intensive sessions (lectures & tutorials) per week              | Same as 2016-2018                                                                                            |
| After 2020 | ORT-BM: Four-week block (11 sessions) under NBBS<br>Three intensive sessions (lectures & tutorials) per week. | Same as 2016-2018. The only change is “Introduction to performance-based code Part C (added since 2022)”.    |

4.2.3. High Rise Development and Compliance (NBC3001)

NBC3001 is a core unit for all Built Environment courses, targeting third-year undergraduates and focusing on high-rise construction. It covers specialized construction methods, statutory regulations, and Building Information Modelling or BIM [88].

In 2018, the unit NBC 3001 was offered within NBBS in a traditional IP-SL format. NBC3001 transitioned to IP-BM in 2019 and then to ORT-BM in 2020. Table 3 details the evolution of these teaching methods.

**Table 3.** The main changes in delivery, assessments, and key contents of NBC3001.

| Time Range | Delivery | Key Contents |
|------------|----------|--------------|
|------------|----------|--------------|

|            |                                                           |                                                                                                                                                                                       |
|------------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2016-2018  | IP-SL: 12 weeks                                           | Introduction to Complex Statutory Controls                                                                                                                                            |
|            | One-hour lecture per week                                 | Analysis & interpretation of construction details                                                                                                                                     |
|            |                                                           | Identification & specification of mandatory regulations<br>Understanding building trades, professions, and authorities                                                                |
|            | Two hours of tutorials per week                           | Specialist construction & statutory controls in multi-unit and high-rise buildings                                                                                                    |
| 2019-2020  | IP-BM: Four-week block (11 sessions)                      | Same as 2016-2018. The only changes are: (1) Integrated design & development using BIM and (2) Application of regulations in high-rise building design                                |
|            | One block offering in this period                         |                                                                                                                                                                                       |
|            | Three intensive sessions (lectures & tutorials) per week  |                                                                                                                                                                                       |
| After 2020 | ORT-BM: Four-week block (11 sessions) under NBBS          | Same as 2016-2018. The only changes are (1) BIM application skills (Revit/ArchiCAD, Navisworks/Revisto) & (2) Analysing, interpreting, and presenting construction details using BIM. |
|            | Three intensive sessions (lectures & tutorials) per week. |                                                                                                                                                                                       |

4.2.4. Advanced Building Surveying (NBC3002)

Advanced Building Surveying (NBC3002) covers statutory controls, enforcement proceedings, and the intersection of occupational health and safety, environmental, and heritage legislation with the NCC [89]. Initially offered through IP-SL formats in 2018-2019, NBC3002 transitioned to IP-BM in 2019 and then to ORT-BM in 2020. Details of these transitions are outlined in Table 4

**Table 4.** The main changes in delivery, assessments, and key contents of NBC3002.

| Time Range | Delivery                             | Key Contents                                                 |
|------------|--------------------------------------|--------------------------------------------------------------|
| 2018-2019  | IP-SL: 12 weeks                      | Interpret Codes and Standards of Class 2 to 9 buildings      |
|            | One-hour lecture per week            | Advise on compliance of design documentation                 |
|            |                                      | Negotiate construction inspections                           |
|            |                                      | Communicate effectively with professionals                   |
|            | Two hours of tutorials per week      | Formulate safe practices for permits and on-site inspections |
| 2019-2020  | IP-BM: Four-week block (11 sessions) | Same as 2018-2019.                                           |

|            |                                                           |                    |
|------------|-----------------------------------------------------------|--------------------|
|            | Three intensive sessions (lectures & tutorials) per week  |                    |
|            | ORT-BM: Four-week block (11 sessions) under NBBS          |                    |
| After 2020 | Three intensive sessions (lectures & tutorials) per week. | Same as 2018-2019. |

5. Results and Discussion

This section evaluates the NBBS course and its four selected units during transitions from IP-SL (2016-2018) to IP-BM (2019-2020), and then ORT-BM (2020 to present). It explores the effectiveness of ORT-BM in enhancing student learning experiences and outcomes based on Quality Indicators for Learning and Teaching (QILT) [90].

5.1. Bachelor of Building Surveying (NBBS) Course

Transitions to IP-BM and ORT-BM significantly altered the NBBS course landscape. Figure 1 highlights the number of NBBS students and their progress rates from 2016 to the present, calculated based on Passed Equivalent Full-Time Student Load (EFTSL) divided by Assessed EFTSL.

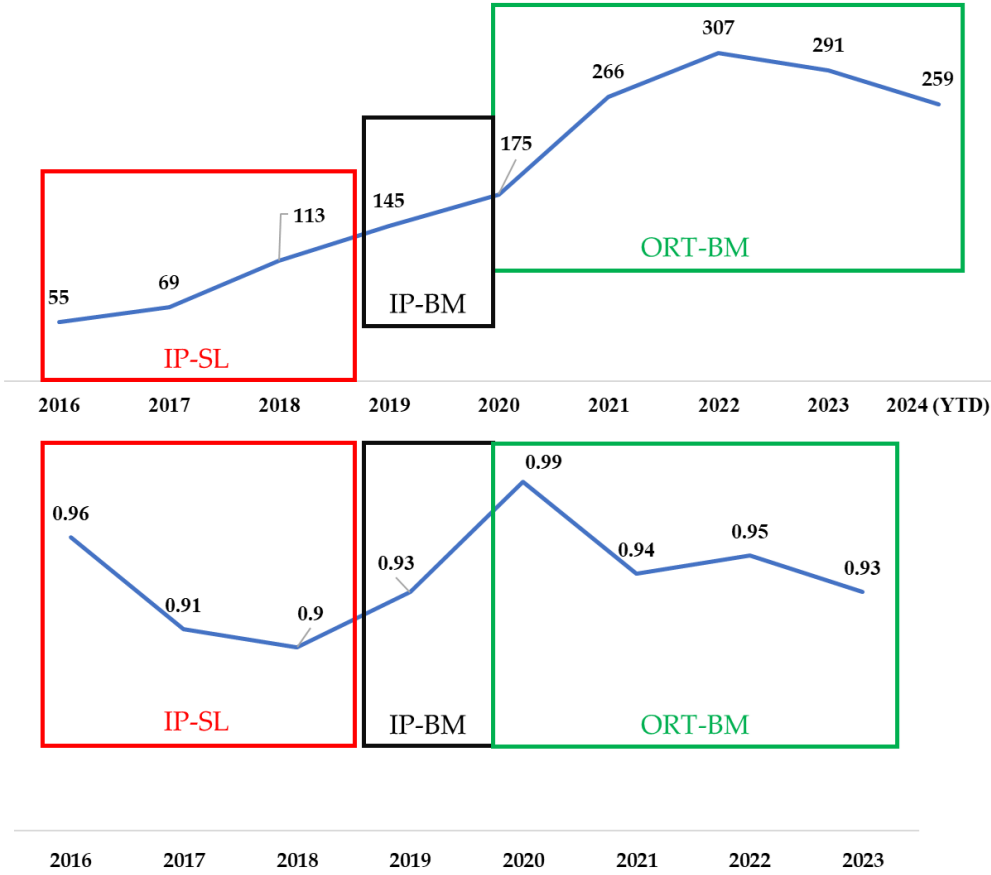


Figure 1. NBBS Students Number (a) and Progress Rates (b).



Figure 1 (a) illustrates a significant increase in NBBS students over seven years, with a rise from 55 in 2016 to 145 in 2019-2020 after transitioning from IP-SL to IP-BM. The shift to ORT-BM from 2020 further accelerated this trend, with a peak during the 2020-2021 lockdown. This successful implementation led Victoria University to continue offering NBBS in ORT-BM even after universities reopened in 2022, resulting in a six-fold increase in students since 2016.

The transition from traditional IP-SL teaching and learning to ORT-BM might have addressed another key parameter in the construction industry: gender equity. The analysis of the QILT data, broken down by gender, is presented in Figure 2.

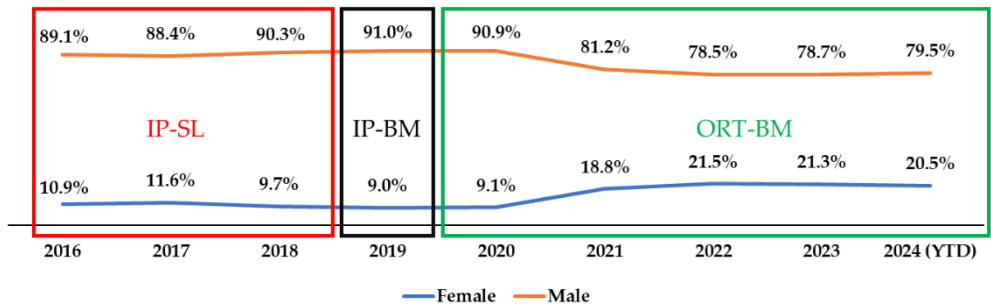
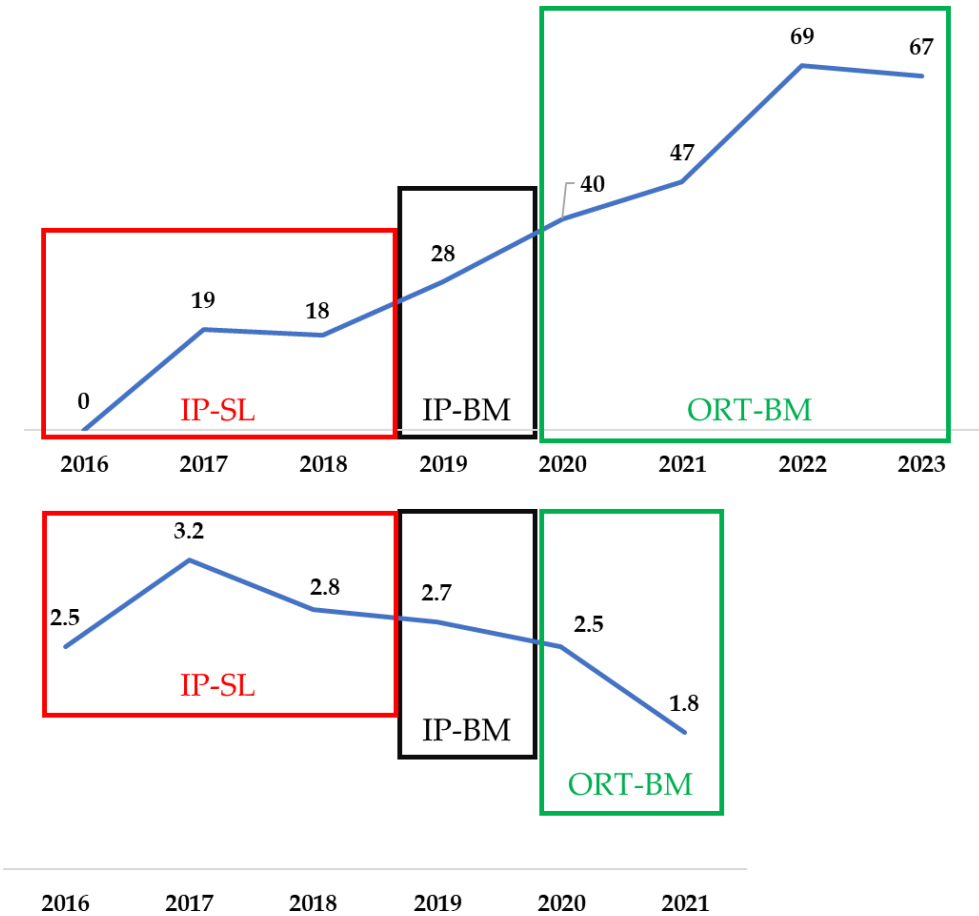


Figure 2. NBBS Students Percentage by Gender.

Figure 2 illustrates a significant increase in female students from 10.9% in 2016 to 20.5% after ORT-BM's introduction in 2020. This rise may be due to ORT-BM's flexibility, allowing students to balance studies and personal responsibilities, and creating a more accessible environment for women male-dominated construction field [91]. On the other hand, the Women Building Surveyors Program, launched with a \$6.3 million budget, notably supported this increase, enrolling 40 women through ORT-BM [92]. Victoria University has successfully enrolled 40 Victorian Women through this program [93] since the ORT-BM approach enabled participants from regional Victoria to attend all classes easily. These results demonstrate ORT-BM's capacity to promote gender equity in male-dominated fields.

Over seven years, the NBBS has significantly improved performance metrics, including a substantial rise in annual course completions, Figure 3(a), and a decrease in the average time to complete the course, Figure 3 (b). The introduction of ORT-BM not only streamlined course completion but also equipped students with skills aligned with current industry requirements, such as Building Information Modelling (BIM) and project-based assessments. These trends are evident from NBBS's establishment as a standalone course at Victoria University in 2016.

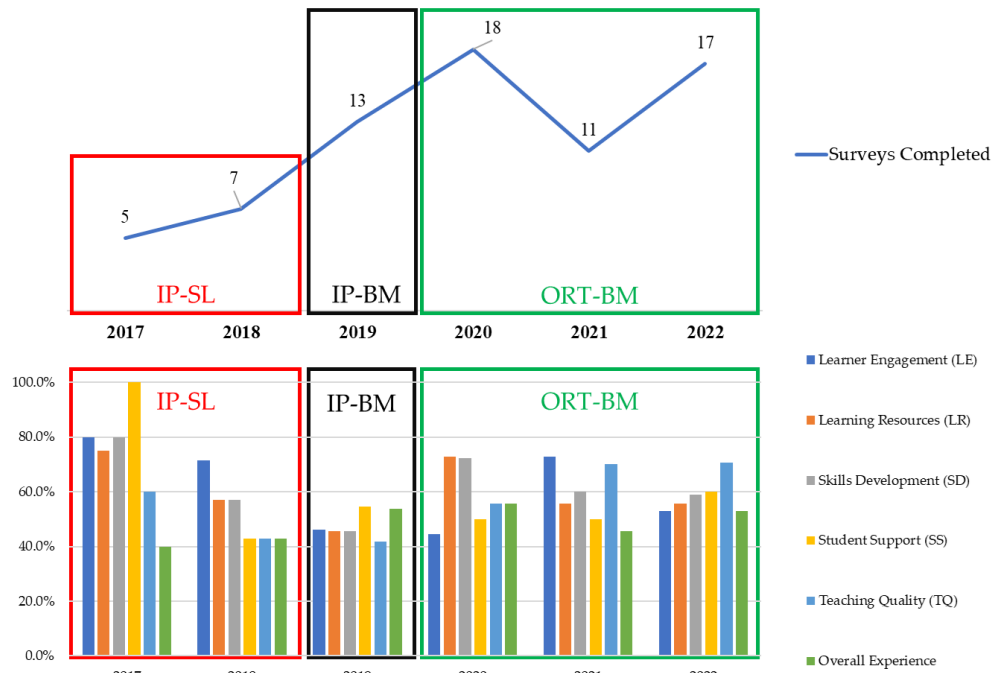


**Figure 3.** Completion Number (a) and Average Years to Complete (b) at the NBBS

Figure 3 (a) shows completion numbers rising from 19 in 2017 to 69 in 2022 with the ORT-BM’s implementation. This approach, fully adopted post-2020, increased completions by offering flexibility and online access, removing geographical constraints. The slight decrease to 67 in 2023 suggests the NBBS program has reached maturity, finding its optimal size and format. Figure 3 (b) reflects a reduction in completion times after transitioning from IP-BM in 2019 to ORT-BM in 2020, highlighting ORT-BM’s efficiency.

Moreover, Victoria University’s Recognition of Prior Learning (RPL) and Advanced Standing policy have significantly shortened degree completion times [94]. Victoria University has created a Credit Calculator page that enables future students to estimate RPL credits based on prior courses [95]. Besides, ORT-BM’s flexible scheduling (e.g., evening sessions), has attracted 71 experienced professionals since 2020, positively impacting completion rates and times.

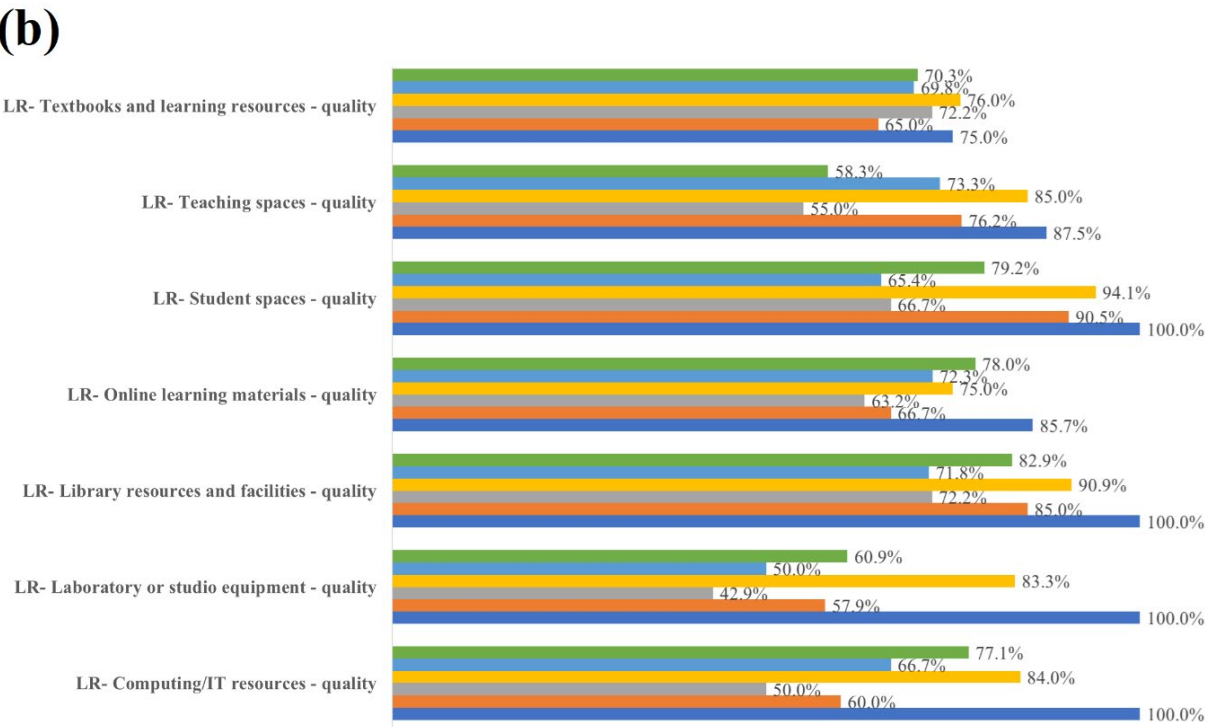
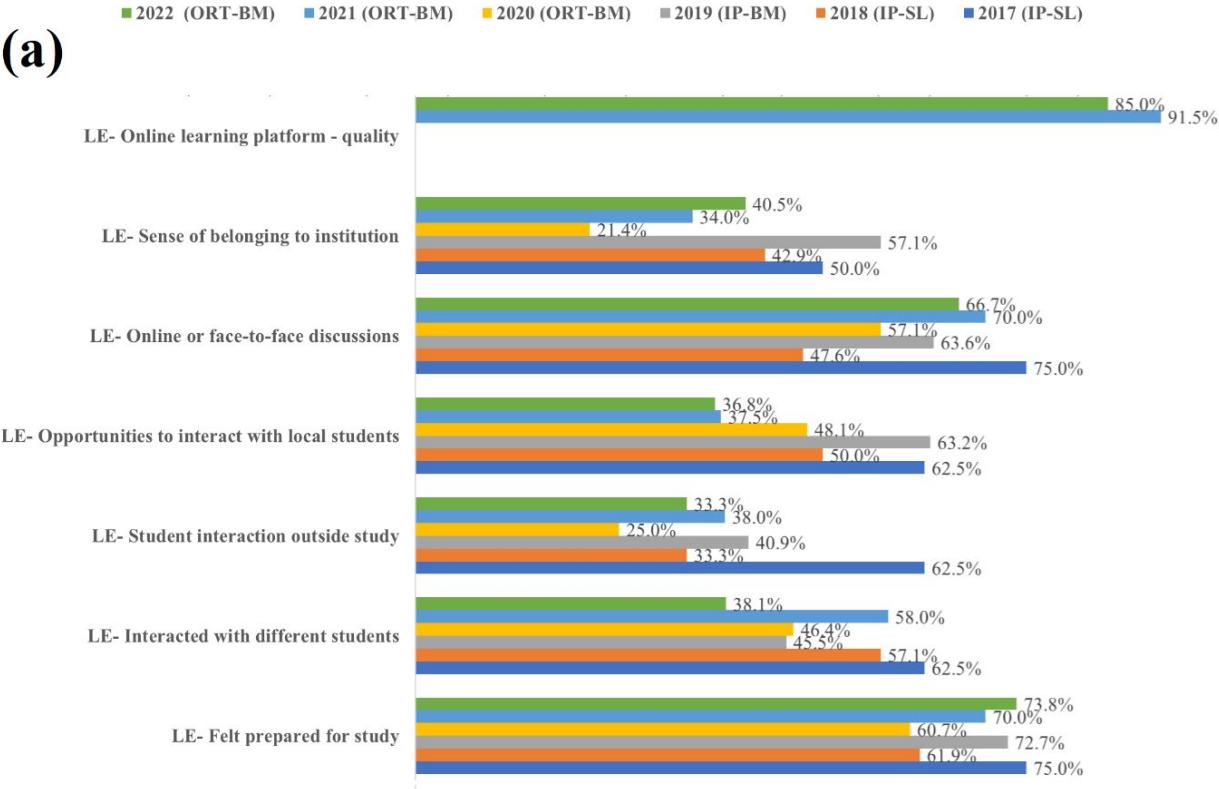
The Students Experience Survey (SES) from QILT data provides insights into the impact of teaching approaches on student experiences. Although SES data isn’t available for individual courses like NBBS, the average feedback across Architecture and Built Environment courses (NBBS, Bachelor of Building Design, and Bachelor of Construction Management) offers a broader perspective. Notably, NBBS continued with ORT-BM after 2022, while others reverted to IP-BM. Figure 4 presents third-year students’ SES responses on Learner Engagement (LE), Learning Resources (LR), Skills Development (SD), Student Support (SS), and Teaching Quality (TQ) between 2017 and 2022.



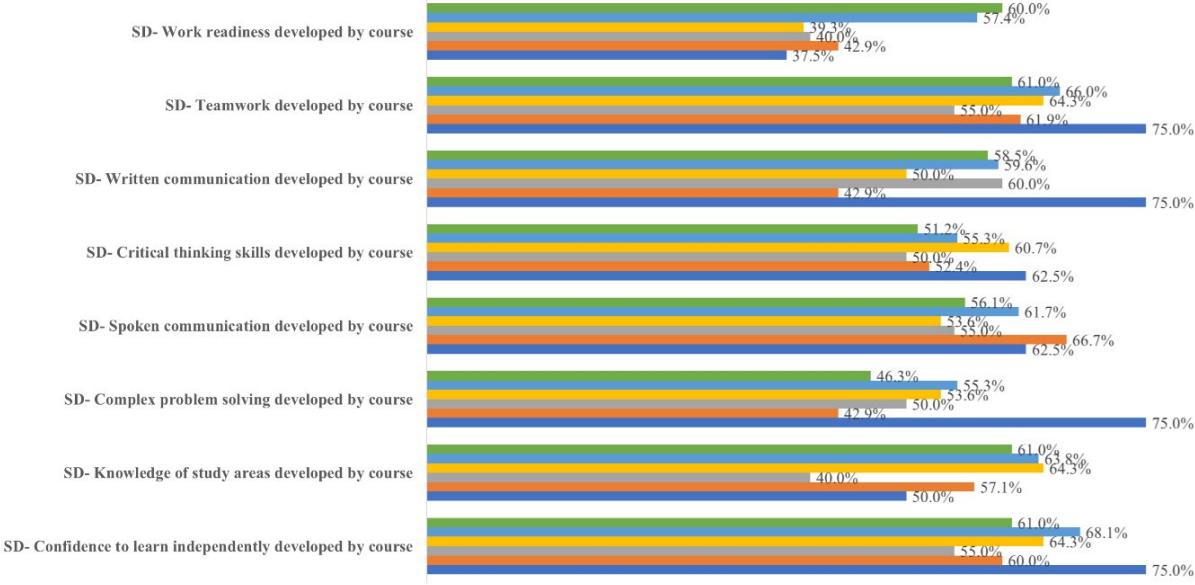
**Figure 4.** Number of Completed Surveys (a) and SES Feedback (b).

Figure 4 (a) demonstrates the SES survey response rates were lowest in 2017, increasing from 5 to a peak of 18 in 2020, suggesting improved data reliability. Figure 4 (b) reveals that while traditional IP-SL scored well in the SS and LE, it rated poorly in Overall Experience, reflecting a gap between expectations and reality. The shift to IP-BM in 2019 saw declines in LE, LR, and SD, but improved the Overall Experience. With the introduction of ORT-BM in 2020, Teaching Quality has increased, while the Overall Experience remained moderate at around 50%, suggesting a need to enhance the “Sense of belonging”.

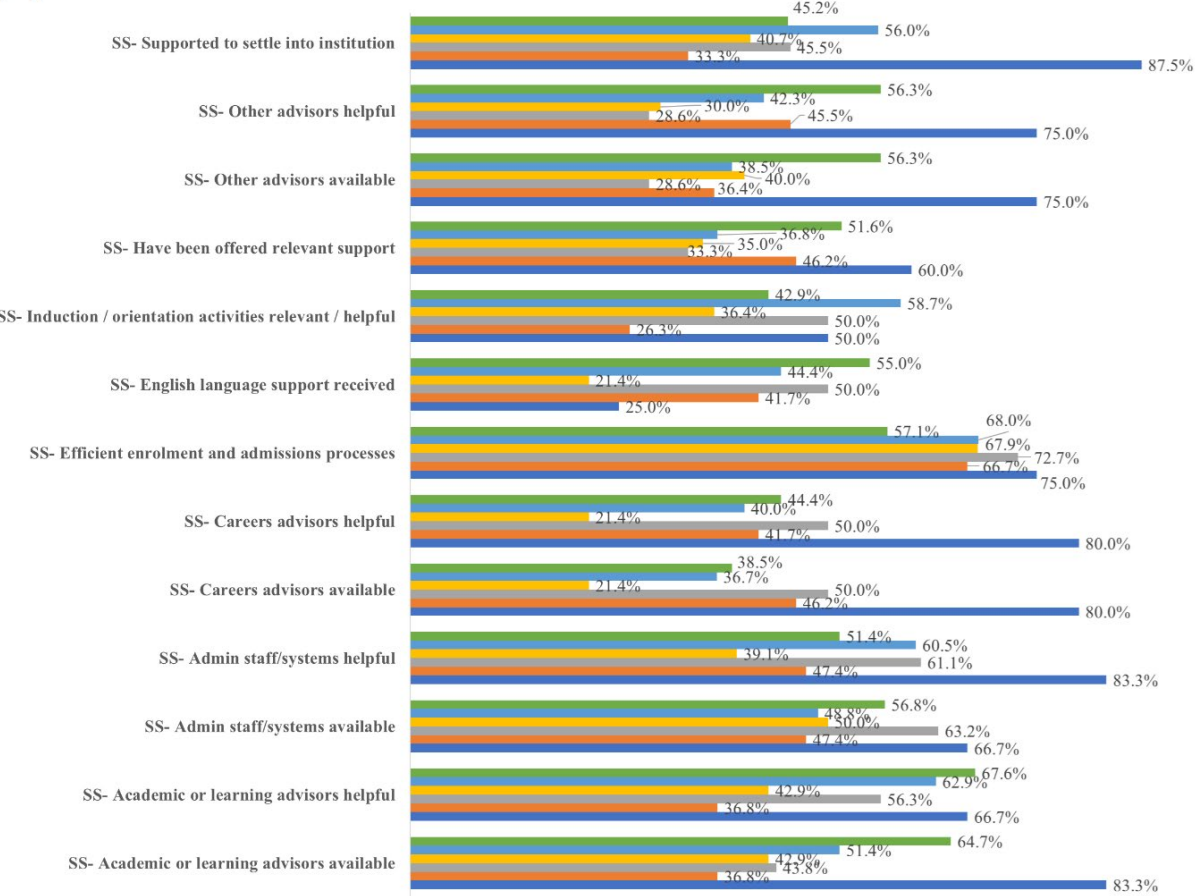
To investigate SES results in more detail, each criterion (i.e., LE, LR, SD, SS, and TQ) between 2016 and 2022, the latest available data, are illustrated in Figure 5.



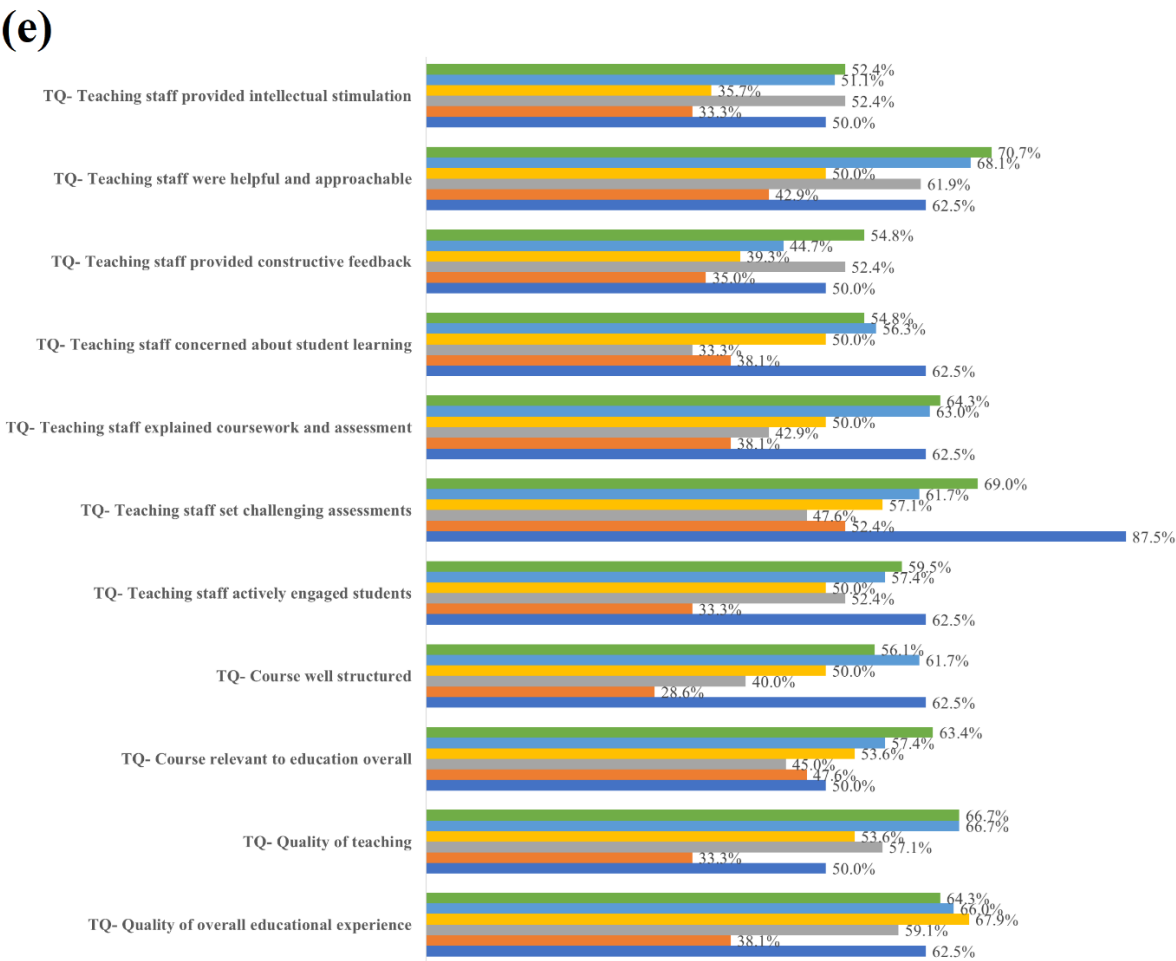
(c)



(d)







**Figure 5.** Completing Students’ Feedback to Five SES Criteria Learner Engagement (a), Learning Resources (b), Skills Development (c), Student Support (d), and Teaching Quality (e) from 2017 to 2022.

Figure 5 (a) indicates low satisfaction with "Student interaction outside of study," "Sense of belonging", and "Opportunities to interact with local students" under LE, especially after transitioning to ORT-BM in 2020. In response, Victoria University enhanced online platforms with real-time Q&A sessions and established the Built Environment Student Club in 2023 to boost engagement. High satisfaction with "Online learning platform quality" in 2021 and 2022 reflects ORT-BM's technological success. Future implementations could incorporate structured peer collaboration tools, moderated discussion forums, and virtual co-curricular activities to improve these outcomes.

Figure 5(b) shows the lowest satisfaction in "Laboratory or studio equipment – quality" across all teaching approaches, indicating a need to update resources. To address this, the Built Environment team developed VR simulation tools [27,96] integrated into units like Building Development and Compliance. These tools have made complex concepts more tangible and received positive feedback.

Figure 5 (c) reveals low satisfaction in "complex problem solving," "knowledge of study areas," and "critical thinking", key employability skills. Victoria University responded by integrating real-world data and scenarios into assessments and launching the "Industry Collaboration Project", providing hands-on experience with actual industry problems like serving as cadet building surveyors.

Figure 5 (d) shows Student Support consistently lagging in satisfaction. Despite Victoria University's strong employability services [97], low satisfaction suggests students may be unaware of these resources. The Built Environment team initiated online engagements, such as webinars, to facilitate direct interaction with career experts.

Finally, Figure 5 (e) highlights challenges in receiving constructive feedback and intellectual stimulation from teaching staff. However, Teaching Quality improved significantly between 2020 and 2022 under ORT-BM, possibly due to curriculum updates and innovative online feedback mechanisms. Enhanced interactive sessions, including guest lectures and group projects, have stimulated critical thinking and enriched education.

5.2. Selected Units of Subject

This section examines four core units within the NBBS program: 1. NBC2002- Building Regulations, 2. NBC2109- Performance-based Solutions for Buildings, 3. NBC3001- High Rise Development and Compliance, and 4. NBC3002- Advanced Building Surveying over three utilized approaches.

5.2.1. Building Regulations (NBC2002)

This section evaluates the annual SEU response rates across teaching approaches to highlight the impact of pedagogical shifts. Figure 6 illustrates these response rates and the average scores.

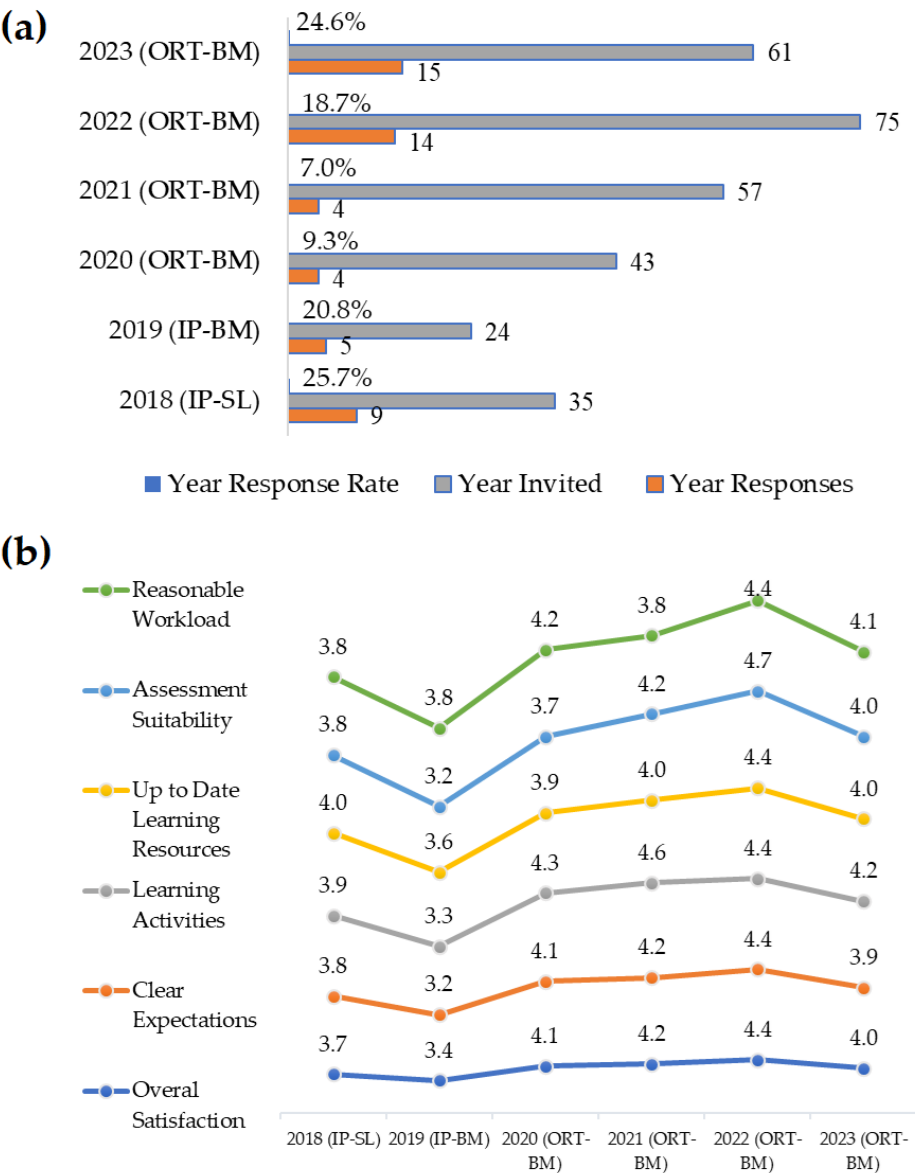


Figure 6. Response Rate to the SEU (a) and Average of SEU Score (b) for NBC2002.

Figure 6 (b) shows stable growth across six criteria, Overall Satisfaction, Clarity of Expectations, Learning Activities, Up to Date Learning Resources, Assessment Suitability, and Reasonable Workload, despite minor fluctuations due to transitioning to IP-BM in 2019. From 2020 onwards, scores consistently exceeded 4, reflecting successful adaptation to new learning approaches. The highest satisfaction was in 2022, coinciding with the return to on-campus activities, with notable improvements in Learning Activities, Clarity of Expectations, and Assessment Suitability, enhanced by VR technology and project-based learning.

5.2.2. Performance-based Solutions for Buildings (NBC2109)

This section examines SEU response rates and scores for NBC2109, shown in Figure 7.

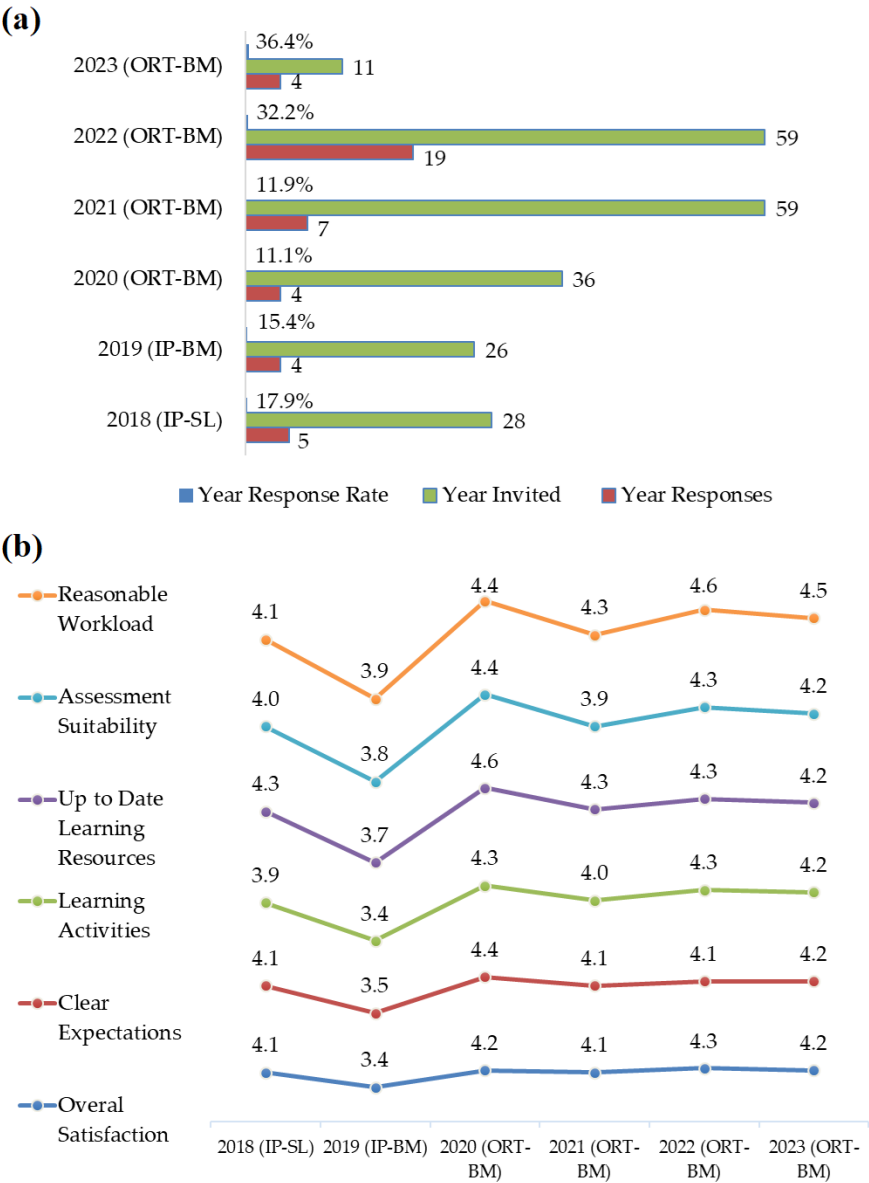


Figure 7. Response Rate to the SEU (a) and Average of SEU Score (b) for NBC2109.

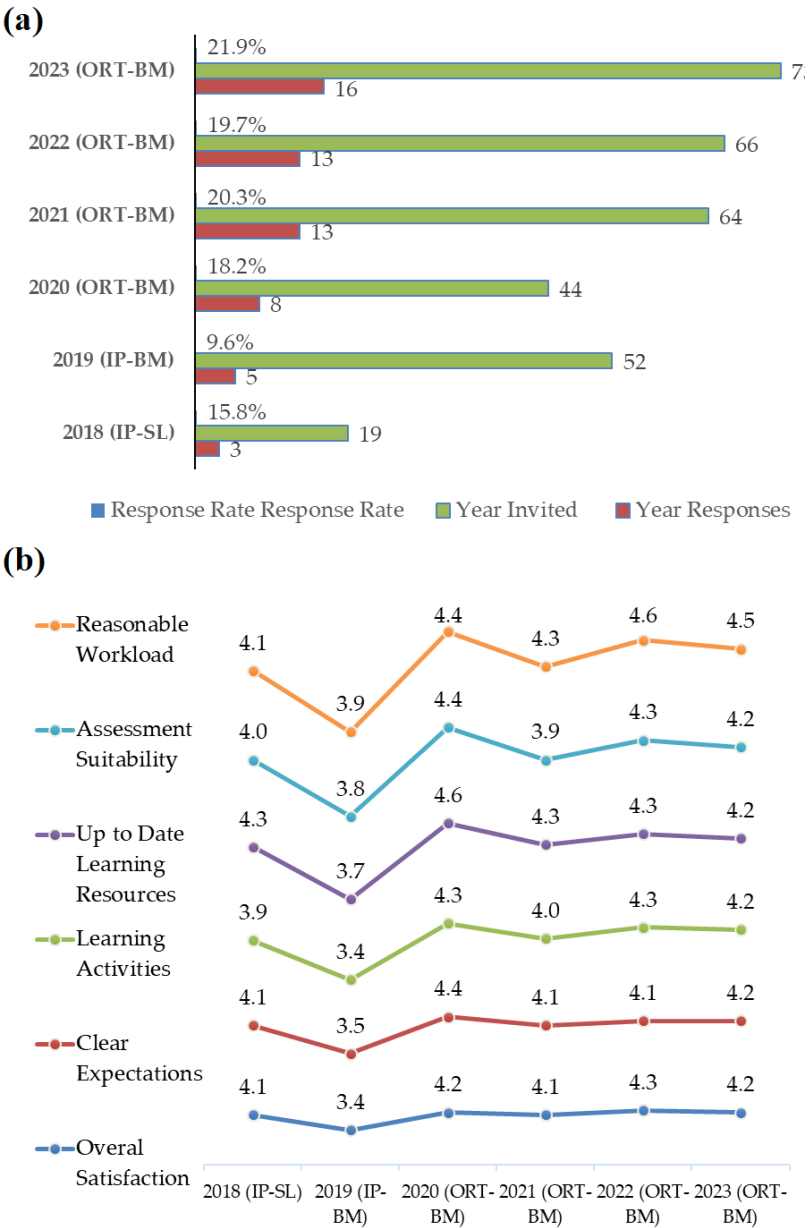
Figure 7 (a) depicts SEU response rates for NBC2109 from 2018 to 2023, showing recent improvements. Response rates were moderate under IP-SL in 2018 (17.9%) and IP-BM in 2019 (15.4%), reflecting modest engagement. A significant drop occurred in 2020 (11.1%), with a slight increase in 2021 (11.9%) during the ORT-BM transition. After 2021, rates improved to 32.2% in 2022 and 36.4% in 2023, despite fewer invitations, due to effective engagement strategies like personalized emails, social media outreach, and staff involvement in promoting.

Figure 7 (b) indicates a fall in student satisfaction during the shift from IP-SL in 2018 to IP-BM in 2019, likely due to the challenges of adapting to the more intense BM format. However, satisfaction improved after 2020, with all criteria scoring above 4. ORT-BM particularly enhanced satisfaction in Learning Activities and workload management, reflecting the effective use of digital materials and project-based learning.

In summary, implementing the ORT-BM approach for NBC2109 after the adaptation period in 2020 and 2021 improved student interaction and feedback rates. This progression may suggest the effectiveness of adaptive responsive strategies like personalized online communication and participatory educational environments, such as project-based learning, under ORT-BM.

5.2.3. High Rise Development and Compliance (NBC3001)

This section investigates NBC3001 as another case study. Figure 8 displays the annual average response rate and mean SEU scores.



**Figure 8.** Response Rate to the SEU (a) and Average of SEU Score (b) for NBC3001.

Figure 8 (a) highlights an increase in response rate after transitioning to ORT-BM in 2020. The anonymous online feedback and extended response time improved the quality of teaching insights,

encouraging more honest and constructive feedback, which contributed to enhanced teaching quality.

Figure 8 (b) indicates enhanced overall satisfaction for NBC3001 since 2018. The shift from IP-SL to IP-BM initially increased SEU rates, though they declined with the 2020 transition to ORT-BM. The incorporation of BIM tools like Revit and Navisworks improved student feedback on Learning Activities and Assessment Suitability. This highlights ORT-BM’s strength in preparing students for industry roles requiring advanced technical proficiency. The full implementation of ORT-BM and strategies like introducing BIM applications and revising assignments led to continuous SEU rate increases. From 2021-2023, ORT-BM achieved an average satisfaction score of 4.4, enhancing Learning Activities and access to up-to-date resources. In conclusion, ORT-BM outperformed previous models in student satisfaction, demonstrating the effectiveness of innovative strategies.

5.2.4. Advanced Building Surveying (NBC3002)

This section explores student responses to the SEU for NBC3002. Figure 9 displays the number of SEU responses and the annual average satisfaction across six different criteria.

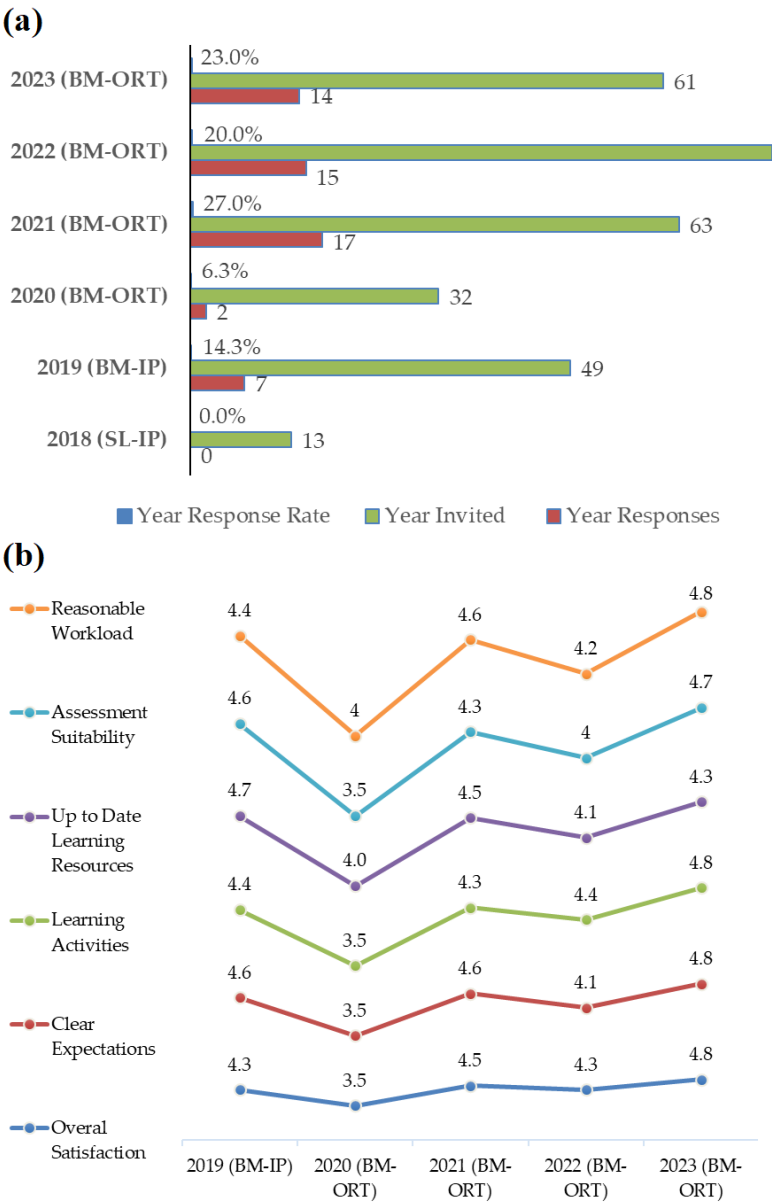


Figure 9. Response Rate to the SEU (a) and Average of SEU Score (b) for NBC3002.

Figure 9 (a) illustrates no SEU responses in 2018 despite 13 invitations, likely due to ineffective survey distribution. From 2019 to 2023, response rates improved, except for a drop in 2020 during the IP-BM to ORT-BM transition. Rates peaked at 27% in 2021 and 23% in 2023, following personalized invitations and increased instructor encouragement.

Figure 9 (b) indicates continuous improvement in the student experience from 2019 to 2023, particularly after fully implementing ORT-BM in 2021, following a temporary decline during the 2020 lockdown. This improvement is evident in key areas like Up-to-Date Learning Resources, Assessment Suitability, and Clear Expectations, driven by 24/7 access to materials and a well-structured online plan

## 6. Limitations and Future Directions

This section discusses the limitations of the ORT-BM approach and recommends future research directions. While ORT-BM improves engagement and satisfaction, it may require adjustments for at-risk students, such as non-native English speakers or those with limited technological access. Previous studies by [98] and [99] highlight that intense virtual environments can overwhelm students' cognitive capacities, especially those with special needs. Therefore, adapting ORT-BM to better manage information flow and support these students' unique needs is essential. Besides, using digital platforms might create a digital divide, disadvantaging students without reliable technological access. Educational platforms must be user-friendly and accessible to all, regardless of technical skills or backgrounds.

Future research should explore hybrid learning models that apply CLT principles to balance cognitive demands with user-friendly and flexible environments, making digital learning more inclusive. A scaffolding approach, which breaks down complex tasks and offers structured support, could help mitigate cognitive overload and aid at-risk students in better understanding course materials. Additionally, studies should focus on designing platforms that are accessible and don't heavily rely on technical skills, ensuring inclusivity for all students.

## 7. Conclusions

This paper quantitatively evaluates the ORT-BM approach for delivering the NBBS program at Victoria University, comparing it with traditional IP-SL and IP-BM methods. The findings highlight the following key points.

- Higher enrolment and completion rates with ORT-BM demonstrate the effectiveness of this approach in supporting students through to course completion more quickly;
- SEU data shows improvements in student satisfaction, particularly in Learning Activities, Clear Expectations, and Assessment Suitability, likely due to technology integration, 24/7 access to materials, innovative virtual tools like BIM, and real-world project-based assignments; and
- Increased female enrolment suggests ORT-BM's flexibility and accessibility appeal to women, mitigating gender intimidation issues common in in-person settings and contributing to a more inclusive learning environment.

However, the study also identifies challenges associated with ORT-BM:

- Some students, especially those needing more time or with limited technological access, find the model challenging. Strategies like scaffolding and peer support systems could help mitigate these challenges, ensuring all students benefit from the model; and
- The digital divide remains a concern, requiring institutions to provide necessary tech access or alternatives to ensure equitable learning.

The findings underscore the potential of ORT-BM to reshape higher education by offering a model that not only meets the needs of diverse student populations but also addresses critical industry demands for timely and practical knowledge transfer. By integrating industry-relevant tools and emphasizing gender equity, this model equips graduates with the skills and confidence to succeed in rapidly evolving professional fields. Addressing the identified challenges can promote gender diversity and inclusivity in such areas.



Quantitative evidence supports the scalability and adaptability of ORT-BM across various educational contexts, enhancing access and success in higher education. Future research should explore hybrid learning models that balance cognitive load with accessibility and flexibility, particularly focusing on enhancing the "sense of belonging" through innovative engagement strategies. Incorporating qualitative insights could further enrich the evaluation of ORT-BM by providing a more comprehensive understanding of students' experiences and the nuanced impacts of this approach.

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