Exploring College Students' Online Platform Learning in the Transportation Planning Course

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Abstract: In the COVID-19 era, many universities quickly adopted digital learning to overcome the health-related issues with physical Face to Face teaching, yet this switch presented challenges with achieving learning outcomes and ensuring teaching quality. The field of Transportation was heavily affected by these challenges. This paper explores students' opinions of one online learning platform - TronClass platform - at the National Taiwan Ocean University in Taiwan. Research samples were undergraduate students who enrolled in the Transportation Planning course from September 2021 to January 2022. The questionnaire included 27 items with a five-point Likert scale and 40 valid questionnaires were collected. The Importance-Performance Analysis with four quadrants was used to analyse these 27 items. The results found that "Speed of response" and "Login identity verification" belong to Quadrant II and thus were considered very important but had a low satisfaction rating. Teaching improvement strategies are discussed based on the research findings.

Keywords: Transportation Planning, Course, TronClass, Importance-Performance Analysis (IPA)

1. INTRODUCTION

E-learning has become an important teaching and learning tool in universities in recent years, especially during COVID-19 period due to reduced physical mobility and a need to move from Face to Face teaching. This need has now become an accepted reality and familiarization with online learning means it has now become embedded, commonplace, and looks set to continue (Neuwirth et al., 2021). However, although it can bring many advantages and supplementary teaching effects, such as flexible learning time and location, unlimited access, convenient reuse and sharing for knowledge, teaching material (e.g. paper) reduction; challenges and disadvantages remain. For example, a lack of F2F feedback, increased teaching preparation time for the instructor[1], potential frustration, anxiety, and confusion for users (Alqudah et al., 2021; Aduba and Mayowa-Adebara, 2022). Teaching platform course studies have been widely applied in many fields (Wu et al., 2015; Al-Fraihat et al., 2020; Al-Maroof et al., 2021; Chao et al., 2021;). However, to date, course studies on transportation related fields for online teaching platform are still limited, especially in Taiwan. Regarding transportation course-related studies, for example, Bauk and

[1] With online facilities if problems exist or the instructor does not have knowledge to operate the online platform, it might increase extra time to deal with unexpected problems at the expense of teaching time.

Radlinger (2013) investigated web-based e-learning at a maritime higher education institution. Yurzhenko (2019) used "Maritime English for professional purpose" to improve students' English abilities by introducing the element of gamification in the course (e.g. QR code quest).

Also, traditional transportation planning courses involve theoretical and software analysis (e.g. logit model), and students might feel bored since such a practical course requires transportation know-how and background. Most students in the university do not have internships or real working experiences in transportation-related organisations (e.g. governmental divisions, transportation companies, consulting companies, etc.), and this results in them thinking such courses are purely theoretical in training and they thereby face challenges in maintaining learning interest. For example, continuing, cooperative, and comprehensive (3C) is an important evaluation process in metropolitan transportation planning. Yet, most students might not realise its real practical implication and only remember these terms in the textbook for preparing for the exams. A key issue with online platform learning for transportation courses is the challenge of conveying this practical angle. This is a challenge that many subjects that are less practical need to face (e.g. Philosophy or English Literature).

In addition, it is well known that transportation planning can improve human health (e.g. safer living environment, environment pollution mitigation, etc.) through effective transportation policy implementation. However, very few students understand how transportation policy is formed. Their learning processes lack practical linkage and problem-solving reflective competencies. In order to fit the research gap regarding teaching platform application in the transportation course and provide students with useful skills to solve real transportation practice problems, based on a questionnaire survey, this paper uses "National Taiwan Ocean University (NTOU) in Taiwan" as a case to explore students' usage satisfaction and performance through introducing TronClass platform[2] in the transportation planning course. The research findings can help transportation (and other subject) teachers understand students' learning situations and further adjust teaching program and strategies. Also, it can help policy makers of the university effectively allocate teaching resources and provide appropriate assistance for the teachers/students and achieve improved teaching/learning performance.

2. Measurement Items

There are many factors (e.g. students' and teachers' characteristics, learning environment condition, etc.) that might affect students' opinions regarding platform usage. Based on a number of past studies (Alhabeeb and Rowley, 2018; Tseng et al., 2018; Tseng et al., 2020), five dimensions with 27 measurement items were selected to analyse for the Importance-Performance Analysis in this study. We describe these contents below.

2.1 Information Infrastructure and System Design

To use TronClass fluently, the minimum broadband is 4Mbps for each person. The more bandwidths are provided for internal and external users, the quicker the response speed of the platform operation will be, making it more effective (Puri, 2012; Alhabeeb and Rowley, 2018; Mwakisole et al., 2019). Also, TronClass's technical infrastructure should be reliable for users and

[2] TronClass is a full-process immersive interactive teaching management platform (Chao et al., 2021). This platform combines cloud technology, big data analysis and interactive teaching methods to help teachers analyse individual student's learning situation and provide effective learning resources.

support multiple devices (Musa and Othman, 2012; Lui et al., 2013). In NTOU, the campus network hardware of information infrastructure and system design is constructed and maintained by the Office of the Library of Information Technology. The office staff take charge of the online learning management system. Based on past studies (Musa and Othman, 2012; Puri, 2012), this dimension is separated into four measurement items: speed of response; supporting multiple devices; reliable technical infrastructure, and; network infrastructure.

2.2 Functions of TronClass

TronClass is a web-based platform that provides various learning functions. It is argued that both convenience, and a secure login procedure are necessary functions for a user to operate TronClass (Alhabeeb and Rowley, 2018; Phutela and Dwivedi, 2020). Alhabeeb and Rowley (2018) emphasised the importance that any e-learning platform (e.g., TronClass) must be able to support multiple types of browsers to open the website. Alseelawi et al. (2020) indicated that an e-learning platform should provide an interactive environment between the trainer and the trainee. Lowenthal et al. (2017) found that an e-learning platform should fulfill the function of online meetings for teaching. Also, ease of surfing the course contents, availability of communication with users, and graphic design are important factors any e-learning platform needs to have (Alseelawi et al., 2020). Based on past studies (Selim, 2007; Alhabeeb and Rowley, 2018), this dimension is separated into seven measurement items: Login identity verification; the convenience of browsing; containing a variety of interactivities; ease of surfing the course contents; communication and discussion with users; the graphic design of the web page, and; using online meetings for teaching.

2.3 Students' Characteristics

In order to make TronClass more suitable for learning, the student perspective must be emphasised (Selim, 2007). Thus, it is necessary to know whether students enjoy the platform. Also, students' habits of learning (e.g. mobile-learning, online learning with computers is another important factor to affect their learning style preferences (Abdel-Gawad and Woollard, 2015). Phutela and Dwivedi, (2020) showed that students embraced 'self-learning' through e-learning teaching models, which acted as a significant communication bridge between student and teacher interactions. Al-Fraihat et al. (2020) explained that social interaction was a key factor of success in computer-supported collaborative learning and significantly affects student learning. Based on past studies (Abdel-Gawad and Woollard, 2015), this dimension is separated into seven measurement items: experience and knowledge about computers; the level of enjoyment while using TronClass; willingness to participate in TronClass; learning style preferences as mobile-learning and online-learning with computers; students' transportation management knowledge; students' self-learning abilities, and; students' teamwork abilities.

2.4 Teachers' Characteristics

In general, teachers' characteristics might affect students' willingness to use TronClass platform. For example, teachers should have the necessary skills of technology to effectively arrange course schedules for students. Abdel-Gawad and Woollard (2015) stress that teachers should provide a well-structured course with activities and contents for students, and have friendly teaching skills to motivate students' learning interests (Selim, 2007). In addition, teachers should have sufficient knowledge to teach the course content and provide feedback/responses to the students' questions (Tseng et al., 2020). Al-Fraihat et al. (2020) indicated that teachers' teaching attitude is an

important factor affecting students' learning satisfaction. Jin et al. (2021) found teachers' teaching attitudes under the pandemic period can promote students' online learning. Based on past studies (Alhabeeb and Rowley, 2018), this dimension is separated into the following five measurement items: the teacher's IT knowledge and online teaching experience; the teacher's transportation planning knowledge; the teacher's well-structured teaching contents and activities in the courses; teacher's ability to motivate students to use TronClass, and; teacher's friendliness when teaching.

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2.5 University Technical Support

It is argued that teaching platforms (e.g. TronClass) should be provided with effective technical support in order to achieve higher user satisfaction and performance (Puri, 2012; Alhomod & Shafi, 2013). For example, a high quality university Wi-Fi environment is a necessary network service for users when using TronClass (Selim, 2007; Alhomod & Shafi, 2013; Karkar et al., 2020). Al-Maroof et al. (2021) indicated organisations must provide support for users when using the platform. University technical authorities should provide a TronClass user manual for students/teachers/staff, and help users achieve self-learning abilities (Selim, 2007). In order to encourage users (e.g. teachers, students) to use TronClass, the university should implement certain strategies to encourage users to outline any problems and possible suggestions when using TronClass (Selim, 2007). Then the technical team of the university can appropriately help solve the problems based on these user comments. In NTOU, the Center for Teaching and Learning and the Office of Library and Information Technology[3] offers a consultation service to users regarding the use of TronClass. University authorities also continuously consult with internal and external experts (e.g. TronClass providers and professors who have information backgrounds in the universities) and refer to their advisory service to improve TronClass services. After consulting with providers and other users, the university often gives TronClass an upgrade to acquire and enable new functions or modifications. For smaller problems that are found by teachers or students, the university collects details on those issues and reports them to the provider. The provider would repair the problems by schedule according to the severity of the problem. In order to encourage students to use TronClass, NTOU offers microcredit Courses and lectures on TronClass for students to motivate them to apply for the courses by themselves. When students passed the threshold of each course, they would receive the corresponding credit. The questionnaire was developed based on past studies (e.g. Flood, 2004; Selim, 2007; Puri, 2012; Alhomod and Sahfi, 2013; Lui et al., 2013; Abdel-Gawad and Woollard, 2015; Alhabeeb and Rowley, 2018), the five dimensions and 27 items are shown in Table 1.

[3] Center for Teaching and Learning and Office of Library and Information Technology: https://li.ntou.edu.tw/?Lang=en

Table 1. Research dimensions and items

Dimension	Labels	Items	Description	Source
Information Infrastructure and system design	S1	1. Speed of response	To use TronClass, the minimum broadband is 4Mbps. When the university provides high-quality bandwidths, the TronClass speed of response will be more rapid.	Musa and Othman (2012) Puri (2012)
	S2	2. Multiple operation system devices	TronClass can be operated on PCs, mobile phones, and tablets. It can support Windows, Mac OS, Android, and iOS.	Lui et al. (2013); Alhabeeb and Rowley (2018)
	S3	3. Reliable technical infrastructure	In NTOU, TronClass is deployed in the university's server and can support 2,000 concurrent users simultaneously and can upgrade the server's core and ram in the future.	Alhabeeb and Rowley (2018)
	S4	4. Network infrastructure	The network infrastructure of TronClass is provided and maintained by NTOU staff.	Karkar et al. (2020); Phutela and Dwivedi (2020)
Functions of TronClass	S5	1. Login identity verification	Users could use their university accounts and passwords with personal preference to log in to the Tronclass platform.	Selim (2007); Alhabeeb and Rowley (2018); Phutela and Dwivedi (2020)

	S6	2. Web browsing services	TronClass can be used by various browsers, such as Chrome, Safari, Firefox, and Edge. For mobile devices, TronClass offers an application that can be installed on mobile devices such as smartphones, and tablets.	Puri (2012); Alhabeeb & Rowley (2018)
	S7	3. Various interactivities	TronClass provides various interactive messages (e.g. pictures, etc.) and attracts users to participate in various course functions, such as video teaching, file sharing, interaction messages, pages and external links, assignment announcements, exams, feedback, etc.	Alhabeeb and Rowley (2018); Alseelawi et al. (2020)
	S8	4. Ease of surfing the course contents	TronClass offers the service of surfing the course contents whilst simultaneously using various functions.	Musa and Othman (2012); Alhabeeb and Rowley (2018); Alseelawi et al. (2020)
	S9	5. Communication and discussion with users	Users can easily communicate with others when using TronClass to exchange messages.	Alhabeeb and Rowley (2018); Alseelawi et al. (2020)
	S10	6. The graphic design of the web page	The various interface design of TronClass can help users to easily understand learning contents.	Musa and Othman (2012); Puri (2012); Alomran et al. (2020)
	S11	7. Using online meetings for teaching	TronClass can offer an online meeting activity (e.g. group discussion, test, etc.) for teachers and students.	Martin and Parker (2014); Lowenthal et al. (2017)
Students' characteristics	S12	1. Experience and knowledge about computers	Students need sufficient experience and knowledge about computers or information technology to use TronClass.	Abdel-Gawad and Woollard (2015); Alhabeeb and Rowley

				(2018)
	S13	2. The level of enjoyment while using TronClass	Students could enjoy the learning process when using TronClass.	Alhabeeb and Rowley (2018)
	S14	3. Willingness to participate in TronClass	Students could actively use TronClass for obtaining useful learning knowledge and feedback.	Alhabeeb and Rowley (2018); Phutela and Dwivedi (2020)
	S15	4. Learning style preferences (e.g. mobile learning, online-learning with computers)	Students can use various digital devices to learn comprehensive knowledge (e.g. website content, video, etc.) and improve traditional learning limitations (e.g. limited learning scope of textbooks).	Abdel-Gawad and Woollard (2015); Alhabeeb and Rowley (2018)
	S16	5. Students' transportation planning knowledge	When students have enough transportation planning knowledge (e.g. trip, node, links, travel time, transportation system, accessibility, location choice models, transportation supply and demand analysis, project evaluation, etc.), they can achieve better learning outcomes when using TronClass.	Tseng et al. (2018); Tseng et al. (2020); McCain et al. (2023)
	S17	6. Students' self-learning abilities	Students can effectively develop active learning abilities by exploring the TronClass platform process.	Phutela and Dwivedi (2020)
	S18	7. Students' teamwork abilities	Students can develop teamwork abilities by using group discussions, and also share feedback with other users.	Al-Fraihat et al. (2020)
Teachers' characteristics	S19	1. Teacher's IT knowledge and online teaching experience	When teacher's IT knowledge is good, he (she) can effectively use TronClass's functions and reduce time wastage when delivering the lectures.	Alhabeeb and Rowley (2018)

	S20	2. Teachers' transportation planning knowledge	When the teacher has sufficient transportation planning knowledge (including transportation practice works, transportation planning theories, transportation network, etc.), he (she) can effectively deliver organised lecture knowledge to the students.	Tseng et al., (2018); Tseng et al. (2020); McCain et al. (2023)
	S21	3. Teacher's well-structured teaching contents and activities	Teachers can effectively design innovative course activities through various and visual course materials and learning resources.	Selim (2007); Phutela and Dwivedi (2020)
	S22	4. Teacher can motivate students to use TronClass	Teachers can make use of the course content of the Tronclass to motivate students and enjoy the learning processes.	Selim (2007); Alhabeeb and Rowley (2018); Al-Fraihat et al. (2020)
	S23	5. Teacher's friendly teaching skills	Teacher's friendly attitude and teaching skills can attract students to concentrate their learning activities and achieve better outcomes.	Selim (2007); Alhabeeb & Rowley (2018); Al-Fraihat et al. (2020)
University technical support	S24	1. University regularly maintains TronClass well.	The university authorities should regularly maintain and upgrade the TronClass facilities to ensure they meet students' learning requirements.	Puri (2012); Alhomod and Shafi (2013)
	S25	2. University provides free TronClass electronic user manual.	The TronClass users have free to download user manuals and understand learning functions and guidelines.	Puri (2012); Alhomod and Shafi (2013)
	S26	3. University continuously consults with experts for advisory service of TronClass.	University authority staff should regularly consult internal and external experts who understand TronClass and adjust service	Selim (2007); Puri (2012)

		functions to fit user demands.	
S27	4. University can motivate or promote students to use TronClass for learning.	NTOU can offer extra incentives (e.g. obtaining extra learning credits in course evaluation) for students who use TronClass.	Flood (2004); Selim (2007)

3.Methodology

3.1 Participators and item measurement

In this paper, the participants were undergraduate students who used TronClass from September 2021 to January 2022 (first semester) and participated in the Transportation Planning course. This course emphasised group-based project work and problem-based learning. Five student-sized groups constituted a team and each finished a term project at the end of the semester. Students were encouraged to be creative when determining potential solutions for solving urban transportation problems in their term projects. The lecturer regularly reviewed the implementation progress of their term projects and provided comments on the TronClass platform. The learning topics included Introduction of Transportation Planning, Transportation Demand Analysis, Aggregate Sequential Demand Model, Aggregate Direct Demand Model, Disaggregate Demand Model, and Transportation Planning Case Studies (e.g. Transit-oriented development in Taipei city, transportation infrastructure investment, Mass Rapid Transit in Keelung City, accessibility and land value, etc.). The teaching slides and students' term projects were uploaded to the TronClass platform, and users could download and provide comments on the website. The number of students was 40, including four sophomores, 31 juniors, and five seniors. The questionnaire was designed to identify the importance level and the performance level of students regarding five dimensions with 27 items. The questionnaire was delivered and collected at the NTOU on 27 December 2021 in the classroom. For each measurement item, a five-point Likert scale was used. The measurement of importance ranged from 1 (very unimportant) to 5 (very important) and the measurement of performance ranged from 1 (very dissatisfied) to 5 (very satisfied).

3.2 Importance-Performance Analysis (IPA)

IPA has been widely used to evaluate services, products, education, and business management fields (Martills and James, 1977; Nazari-Shirokiya et al., 2020). IPA combines measures of importance and satisfaction [4] of each attribute into a two-dimensional grid. The means of importance and satisfaction scores are used as crossing points, and four quadrants were made. Quadrant I, "Keep Up the Good Work" indicated the attributes that were considered important and that performed well. Quadrant II, "Concentrate Here" contained what was considered important attributes but did not perform well and which required focus to improve performance. Quadrant III, "Low Priority" indicated the attributes that were considered less important and did not perform well. Quadrant IV, "Possible Overkill" contained what were considered less important attributes but which were considered to perform well.

The quadrant improvement order is ranked as Quadrant II being the first priority of the improvement area and Quadrant IV as the second priority. The improvement order was fixed by the importance index, and the longer the length of the x-axis, the higher the priority to improve. The contents of the four Quadrants are described in Figure 1.

[4] Here "satisfaction" is used to replace "performance" in the study.

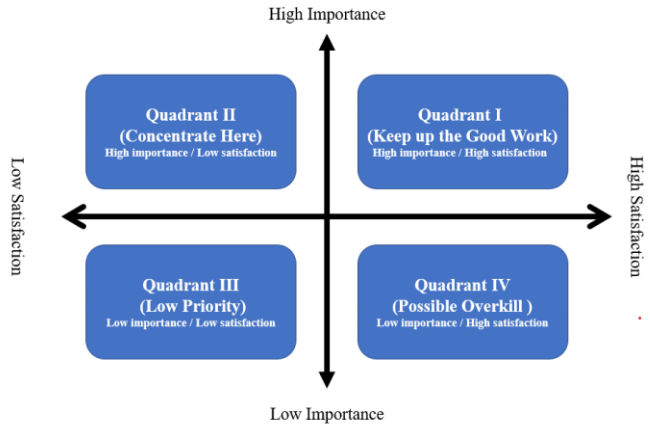

Figure 1 Importance-performance Analysis Matrix (IPA)
Source: Martills and James (1977)

3.3 Regression Analysis

The multiple regression analysis with least squares was used to identify potential variables that affect the student score of the course. Based on past studies (Alqudah et al., 2021; Jiang and Al-Shaibani, 2022; Wang et al., 2022; Yang et al., 2022), the dependent variable is the score of each student. Four independent variables included the gender of the student, the number of absences, the total time of browsing Tronclass (in minutes), and the score of the mid-term exam. The extreme value (e.g. standard deviation) and correlation matrix were checked before conducting the analysis, and the analysis software was IBM SPSS Statistics.

4.Results

Before conducting the formal questionnaire survey, during 15 November – 5 December 2022, four experts whose majors are transportation field and with Tronclass experience were interviewed to review the questionnaire in order to obtain sufficient validity of the questionnaire. Then an initial survey was undertaken on 14 December 2022. Ten samples were collected randomly from the students who studied the Transportation Planning course at the NTOU in order to ensure the questionnaire content was readable. Two samples suggested that in relation to the background section of the questionnaire survey on participants should be added “Have you ever studied a course about transportation?” and “How long do you use Tronclass for this course every week?” These two suggestions were added to our final version of the questionnaire. This paper used Cronbach’s alpha to examine the reliability of the items. The high level of item reliability meant the items were strongly affected by each dimension and implied that sets of items were unidimensional. The results showed that Cronbach’s alpha values were 0.88~0.94 and revealed high reliability.

Based on a questionnaire survey, 40 questionnaires were received. The mean value of importance was 3.5731 and the mean of performance was 3.4463. In Figure 2, the central point (3.4463, 3.5731) is located at the grand-mean scores. Each of the 27 items was located on its Quadrant based on the central point (See Table 2). Items in Quadrant I included item S2, item S6, item S7, item S8, item S10, item S11, item S14, item S15, item S17, item S19, item S20, item S21, and item S23. Results found 48% (=13/27) of items belonged to Quadrant I and revealed students thought 48% of the evaluation items were of high importance and high performance. Quadrant II “Concentrate here” included item S1, and item S5. Quadrant III “Low priority” included item S3,

item S4, item S9, item S13, item S18, item S24, item S25, item S26, and item S27. Quadrant III "Low Priority" included item S3, item S4, item S9, item S13, item S18, item S25, item S26, and item S27. Quadrant IV "Possible overkill" included item S12, item S16, and item S22.

The top three important items were "Login identity verification (S5, 3.9500)", "Multiple operation system devices (S2, 3.8750)", and "Teacher's friendly teaching skills (S23, 3.8500)". TronClass had a secure login that protects the user's data. Support for multiple devices allowed users to use TronClass without being limited by specific devices. Teachers created comprehensive teaching materials and activities in their courses to provide sufficient knowledge and practice for students' learning.

The top three satisfaction items were "Teacher's well-structured teaching contents and activities in the courses (S21, 3.8000)", "Teacher's friendly teaching skills (S23, 3.8000)", and "Teachers' transportation planning knowledge (S20, 3.7750)". Students understand that teachers had a wealth of expertise to teach subjects that could offer effective learning for students. Also, the teacher's friendly teaching attitude helped students pay attention to learning and teaching subjects.

The lowest three importance and satisfaction items were "University provides free TronClass electronic user manual (S25, 3.2250)", "University continuously consults with experts for advisory service of TronClass (S26, 3.1750)", and "Communication and discussion with users (S9, 2.9500)". One possible explanation is that students would not care if the university provided TronClass manuals to them or not since already have solid IT knowledge to use TronClass. Most students do not understand if the university consults with experts and consequently, they might think expert consultation is not important and therefore the score of satisfaction is low.

P-value was used to identify if students' genders and grades showed differences regarding the importance and performance measurement items. The results indicated that there was no significant difference ($P<0.05$).

Table 3 Item mean score of Transportation Planning course

Items	Importance		Performance		Location
	Mean	Std. Deviation	Mean	Std. Deviation	
S1	3.5750	1.0099	3.2000	1.0178	Quadrant II
S2	3.8750	0.9658	3.6000	0.8412	Quadrant I
S3	3.4000	0.9001	3.3500	1.0754	Quadrant III
S4	3.4750	0.8767	3.2000	0.9392	Quadrant III
S5	3.9500	0.9594	3.1750	1.1297	Quadrant II
S6	3.8250	0.8130	3.6250	0.8066	Quadrant I
S7	3.5750	0.9026	3.5750	0.9578	Quadrant I
S8	3.6750	1.0225	3.4750	0.9055	Quadrant I
S9	2.9500	1.0365	2.9750	1.0975	Quadrant III
S10	3.8000	0.8228	3.6000	0.7442	Quadrant I
S11	3.6750	1.0225	3.6000	0.8102	Quadrant I
S12	3.5250	0.9055	3.6500	1.0013	Quadrant IV
S13	3.4500	0.9323	3.3250	0.8286	Quadrant III
S14	3.8500	0.8336	3.5750	0.7472	Quadrant I

S15	3.6500	1.0513	3.4750	0.9334	Quadrant I
S16	3.3500	1.1447	3.5250	1.0374	Quadrant IV
S17	3.6000	0.8712	3.6750	0.9167	Quadrant I
S18	3.4250	1.0099	3.3750	1.0048	Quadrant III
S19	3.8000	0.9661	3.4750	1.0619	Quadrant I
S20	3.7500	1.2960	3.7750	1.2908	Quadrant I
S21	3.8500	0.9487	3.8000	0.8534	Quadrant I
S22	3.4750	1.0858	3.5500	1.0610	Quadrant IV
S23	3.8500	1.0266	3.8000	1.0178	Quadrant I
S24	3.4500	1.1536	3.1750	1.0834	Quadrant III
S25	3.2250	1.04973	3.1750	1.15220	Quadrant III
S26	3.1750	1.00989	3.0750	0.97106	Quadrant III
S27	3.2750	1.13199	3.2500	0.92681	Quadrant III
Total average		3.5731		3.4463	

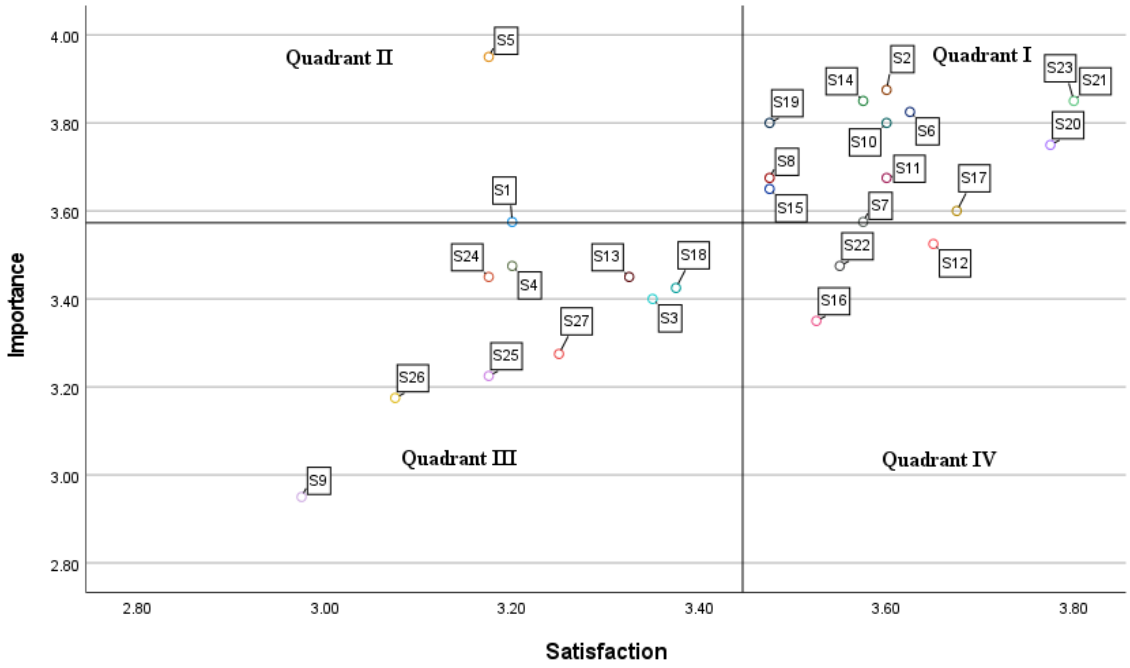

Figure 4.2 IPA Scatter Plot of Transportation Planning Course (n=40)

1). Items in Quadrant I (Keep up the Good Work)

Quadrant I represented high importance and performance, and 13 items were separated into this quadrant, including “Multiple operation system devices (S2)’, “Web browsing devices (S6)”, “Various interactivities (S7)”, “Ease of surfing the course contents (S8)”, “The graphic design of the web page (S10)”, “Using online meetings for teaching (S11)”, “Willingness to participate in TronClass (S14)”,“Learning style preference (e.g. mobile-learning, online-learning with computers) (S15)”, “Students’ self-learning abilities (S17)”, “Teacher’s IT knowledge and online teaching

experience (S19)", 'Teachers' transportation planning knowledge (S20)", "Teacher's well-structured teaching contents and activities (S21)", and "Teacher's friendly teaching skills (S23)".

Quadrant II (Concentrate Here)
Item "Speed of response (S1)" and item "Login identity verification (S5)" belong to Quadrant II and signified that these two items were urgent issues, since most students thought they were very important and were not satisfied with them. Here, students might feel dissatisfied when they cannot log in to the platform, or if the web page does not operate smoothly. These two items were very important because platform operation efficiency and effectiveness might affect students' learning attitudes and outcomes.

Thus, the teachers and university authorities should make more effort to address these issues. For example, regarding increasing the speed of response, the university could provide more website bandwidth and effectively allocate course time and the number of students in the class. In terms of login identity verification, perhaps a questionnaire survey could be implemented to collect users' suggestions and subsequently provide improvement strategies in the future.

2). Quadrant III (Low Priority)
Quadrant III included nine items, including "Reliable technical infrastructure (S3)", "Network infrastructure (S4)", "communication and discussion with users (S9)", "The level of enjoyment while using TronClass (S13)", "Students' teamwork abilities (S18)", "University regularly maintains TronClass well (S24)", "University provides free TronClass electronic user manual (S25)", "University continuously consults with experts for advisory service of TronClass (S26)", and "University can motivate or promote students to use TronClass for learning (S27)". Items in this quadrant were not critical issues, possibly because students may well consider the main system functions to not significantly affect their learning.

3). Quadrant IV (Possible Overkill)
This quadrant included "Experience and knowledge about computers (S12)", "Students' transportation management knowledge (S16)", and "Teacher can motivate students to use TronClass (S22)". Students were very satisfied with these items since they felt these issues were dealt with well. However, the potential explanation that these items were considered low importance is that these issues will not affect their learning when using TronClass.

Regarding regression analysis, the initial result of the regression model was illustrated in Table I. the Independent variable "Gender of the student" was deleted due to its non-significant effect (p-value >0.05).

Table 4 Results of the initial stepwise regression model

Independent variables	Beta (β)	T-value	Sig.
Gender of the student	-0.046	-0.823	0.416
Number of absences	-0.384	-2.882	0.007*
Total time of browsing Tronclass	0.060	0.992	0.328
The score of the mid-term exam	0.549	4.032	0.000*
R=0.949; R^2=0.901; Adj. R^2=0.889			

As shown in Table 5 the first revised regression model was illustrated. The Independent variable "Total number of browsing" was deleted due to its non-significant effect (p-value >0.05).

Table 5 Results of the initial revised regression model

Independent variables	Beta (β)	T-value	Sig.
Number of absences	-0.415	-3.272	0.002*
Total time of browsing Tronclass	0.061	1.009	0.320
The score of the mid-term exam	0.527	3.965	0.000*
R=0.948; R^2=0.899; Adj. R^2=0.890			

As shown in Table 6, the final revised regression model reveals that the number of absences negatively affected the course score (t=-3.167, p=0.003*) and the score of the mid-term exam (t=4.525, p=0.000*) positively affected the course score.

Table 6 Results of the final revised regression model

Independent variables	Beta (β)	T-value	Sig.
Number of absences	-0.399	-3.167	0.003*
The score of the mid-term exam	0.570	4.525	0.000*
R=0.946; R^2=0.896; Adj. R^2=0.890			

5. Discussion and Conclusions

This paper explored usage situations of TronClass at the NTOU based on IPA to investigate students' opinions through a questionnaire. The results of the IPA showed that three items were in Quadrant II, which were "Login identity verification (S5)," "Learning style preference as mobile-learning and online-learning with computers (S15)," and "Teachers' IT knowledge and online teaching experience (S19)" and they are first priority when conducting teaching improvement.

Regarding Login identity verification (S5), this item revealed the lowest satisfaction and highest importance in Quadrant II, and signifies students emphasised platform login safety and convenience and thought this function should be improved. In the classroom, students can use their cell phones with TronClass App to login to the platform after passing the ID and password verification. If students use the university WiFi, they might at times feel the network speed is slow due to two potential reasons. First, the WiFi system might suffer disturbance because of the mountains near NTOU which consequently affects the network message transmission. Second, too many students simultaneously using the TronClass platform and university WiFi, may result in the outcome that they can not quickly login to the platform. Thus, the university authority should actively improve the wireless station function in the teaching building and expand the service volume of TronClass platform in order to maintain network service quality.

According to the research findings, students might think that personal data safety could be further enhanced. For example, the TronClass system could periodically notify users to change their password in order to avoid the risk of hacker attacks. However, currently, there is no strict rule to ask users to change their password regularly. Actually, the compulsory rule to change the password is an unfriendly rule since it might add a burden to users since they must regularly remember the new password. It is suggested that the password setting should also increase the strength of the password, upper- and lower-case letters, a mixture of English letters and also

numbers when using TronClass for the first time. This could effectively improve user safety and avoid hacker attacks.

In terms of Learning style preference as mobile learning and online learning with computers (S15), this item was ranked as the second-highest performance and the lowest importance in Quadrant II. As the education environment changed, students began to be aware that their learning style was changing. Actually, there are many teaching functions (e.g., group discussion and peer review) in the TronClass platform and teachers should appropriately adopt various teaching and evaluating tools to improve teaching quality and increase the fun when using TronClass.

Finally, regarding Teachers' IT knowledge and online teaching experience (S19), this item revealed the importance of IT operation skills for the teachers who use TronClass. Before the COVID-19 period, some teachers were familiar with TronClass at the NTOU, especially in online teaching experience. When COVID-positive students needed online learning help at home, teachers had to have the capability to solve students' online learning problems. In the Transportation Planning course, for example, the trip analysis topic needs logit model software to analyse the research data. The teacher must have thorough knowledge to help students set up the software and solve potential installment problems. It is suggested that university authorities could encourage teachers to use TronClass within various teaching activities, such as examinations and enrollment, and thereby increase and strengthen their usage experiences. The Office of Academic Affairs in the university could also organise teaching workshops for teachers and improve their IT skills and offer one-to-one tutoring arrangements. Also, teaching assistants (e.g. master students) could be recruited to help teachers deal with IT operation problems and reduce the burden on teachers.

Regarding the relationship between the survey results and the student's scores, the regression analysis results that the number of absences negatively affected students' scores. It is suggested that the teacher should regularly observe and track students' attendance situations. The students who frequently miss course learning opportunities might result in learning gaps and consequently affect their learning abilities since they might lack the course's professional knowledge to finish the teacher's assignment. Also, students who have better learning outcomes during the mid-term exam stage will have greater opportunities to achieve a higher overall course score at the end of the semester. Thus, teachers should continuously take care of each student's outcome at the various stages of the semester (especially in the early stage of the semester) and identify their potential learning barriers through various methods (e.g. online testing via Tronclass after finishing learning units). In this way, teaching strategies could be appropriately adjusted based on students' feedback and suggestions.

Four suggestions are provided based on the research findings. First, from the perspective of teachers; teachers could strengthen their IT knowledge by actively learning the current mainstream statistics (e.g. SPSS) and operation research software and participating in various online teaching platform software workshops. Teachers could share experiences with colleagues during formal and informal situations and reduce potential usage barriers when using teaching platforms. Also, teachers could appropriately assign interesting homework or real exam by TronClass in order to effectively evaluate students' learning outcomes and consequently adjust teaching content and progress. For example, students' hometown traffic problems could be assigned as research topics and then students would have more opportunities to understand various cities' traffic characteristics and potential solutions to solve the problems. The teacher can appropriately demonstrate the feasibility of transportation improvement strategies by collecting and analysing practical traffic data or questionnaire survey results (combining disaggregate demand model).

Second, regarding students, it is suggested students can actively provide their TronClass usage barriers, problems, and comments to the university authorities (e.g., the Office of Academic Affairs) through various methods (e.g., physical classroom questionnaire survey, online platform survey). The university authorities and platform providers could then regularly review students' suggestions and improve the function of TronClass. As with the first suggestion, this will also require time and resources to be allocated by the NTOU (and by implication any organisation) to achieve this.

From the perspective of the university authorities, the university should widely use the advantage of TronClass and organise interesting learning activities to attract students to participate and enjoy the functions of TronClass. For example, it can combine student's life experience (e.g. calculating daily commuting trips time, distance, and cost and then evaluating mode choices) as an assignment to enhance the importance of learning transportation planning. Then, appropriately introducing road volume and congestion characteristics issues in assignments and encouraging students to think about how to solve route choice problems. It is believed that such an investigation process can help explore learning motivation and enhance course attendance. Also, it is suggested that university authorities should offer a sufficient budget to help teachers participate in the workshops of the teaching platform and collect the feedback of the users. Based on the consultation with university internal and external experts, TronClass providers, and students' suggestions, the university authority should produce a guidebook for faculty and students and regularly renew the teacher's and students' guideline manual of TronClass. Also, the university authority could compare and consider the experience of other universities regarding teaching platform usage and further adjust system function and services in order to fit the users' needs.

Regarding enhancing teachers' IT skills, the university authorities could help arrange the teaching assistant via one-to-one tutorials to help teachers operate TronClass during the semester start. The university could invite senior teachers familiar with TronClass to share experiences and reduce learning barriers TronClass beginners. After the training is completed, the management unit could follow up to see if there was any significant improvement in the software application and operation of the participants after the training.

From the perspective of the platform provider, this paper suggests TronClass providers maintain a safe and friendly login process for university authorities and users. Also, TronClass users should be periodically notified to update their passwords for the platform. For example, users' passwords should be set up with upper- and lower-case letters, numbers, and special symbols. Furthermore, the university and platform provider could work with authorities to develop a useful TronClass APP service linked to university social media accounts (such as NTOU's official Line account). Then students could access accounts directly from the university's media account without experiencing a complicated verification process. TronClass providers should actively help the university maintain service quality and continuously collected real feedback from the users (including students, teachers, staff, etc.), and provide better system effectiveness. Finally, the platform provider should understand the teaching and learning needs of the university and suggest appropriate suggestions for improving online teaching and learning environments, such as facility upgrades and balancing the Wi-Fi volume of users through adjusting the arrangement of class numbers to avoid poor network quality problems.

The research scope of this paper was limited to a particular Transportation course using TronClass in the university. Future studies could consider various background participants' opinions in other courses and other online platforms (e.g. Zoom, Google Meet, Google Classroom, Moodle, Blackboard, Wechat group platforms, etc.). In addition to IPA analysis, future research

could also use other qualitative methods (e.g. in-depth interviews) or quantitative methods (regression analysis, probit model, structural equation modeling) to analyse participants' responses.

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