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Identifying dimensions and components of student support system in virtual learning: A scoping review

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Abstract:

A student support system (SSS) has a crucial role in the absorption, retention, and success of students in virtual learning. The purpose of this scoping review was to identify and map the available evidence regarding the dimensions and components of the SSS in virtual learning. This study was conducted in accordance with the methodology of the Joanna Briggs Institute (JBI) for scoping reviews. Our search strategy was based on using search engines, such as MEDLINE, EMBASE, Scopus, WoS, CINAHL, ERIC, PsycINFO, ProQuest, and Google Scholar. The articles were published in renowned medical education journals, including Medical Education, Medical Teacher, and Academic Medicine, and the reference lists of identified and reviewed articles were searched manually. The search results were imported into EndNote X20, and after removing duplicates and screenings, 42 studies met the inclusion criteria and were included in the review. A descriptive– analytical approach was employed, including a numerical count of study characteristics (quantitative) and template analysis (qualitative). Five dimensions were identified in the SSS in virtual learning: types of support, domains of support, stages of support, instigating of support, levels of support, and their components and subcomponents. The findings of this study depict a comprehensive roadmap and have an important contribution to the knowledge body of SSS in virtual learning. We suggest system developers, planners, and higher education officials to improve the quality of virtual learning by applying these findings in their planning and decision-making.

Keywords:

Student, support system, template analysis, virtual learning

Introduction

In the era of the twenty-first century, we are witnessing vast progress in technology. Technology has overshadowed all aspects of our lives and plays an important role in every possible field, such as education. Virtual education is one of the products of technology.[1]

With the creation of an intranet for students by the University of Illinois in 1960, virtual education was born.[2] It has exploded during the last few years, and after the coronavirus disease 2019 (COVID-19) pandemic, it has grown globally and significantly and is undergoing a period of rapid and unprecedented changes.[3,4]

Due to the geographical distance between student and institution, virtual education students face more cognitive, technical, and administrative problems compared with traditional students. This separation affects the teaching and learning process and leads to decreased motivation, decreased student engagement, and psychological problems, such as confusion, isolation, and stress. In addition, sometimes, they have insufficient self-management and self-directed learning skills and all these matters cause them

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to drop out of school.[5] Therefore, a big problem for virtual education institutions is high failure and low retention rates, to the extent that the persistence in virtual education has been often 10%–20% lower than in traditional ones and less than 50% of virtual education students finish their courses.[6] There is no reliable statistics on the success or dropout rate of students in virtual education in Iran.

To retain students and achieve success in virtual education, special proceedings need to be taken by the educational institution.[7] In this regard, the first and most important action of an educational institution is to consider quality control indicators. The quality of educational institutions and their service quality is an effective factor in the learning process and one of the indicators of accreditation and the basis of academic excellence.[8] For this reason, the necessity of developing a SSS as a service quality indicator becomes apparent and mandatory.[9]

The term student support is used to describe a wide range of services that help the learner achieve the learning goals, acquire the necessary knowledge, expertise, and skills, and successfully complete their education.[10] The support creates a sense of self-direction, management, control, and sense of belonging to the academic community in the student. In general, these cause a sense of satisfaction and motivation in the student, cause stability in the program,[11] and consider students' emotional, cognitive, and social needs.[12]

Simpson classified the structure of SSS into academic support and nonacademic support. The concentration of academic support is on teaching and cognitive and knowledge issues of a course. Supporting students in the organizational and emotional aspects of their study are parts of nonacademic support.[13]

Mohammadimehr's study emphasizes that the components of student support system (SSS) include "scientific–cognitive," "systematic," "human resource," "emotional," "technical," and "financial–economic" support.[14] The results of various studies have shown that the use of appropriate student support leads to the success of students in virtual education.[15-17]

Proactive motivational support theory was drawn from Dweck's self-theory, and Anderson's proactive support and strengths approach of Boniwell are an individual, interactive, and motivational theory of student support that provides individualized student support, which should be considered as the basis of providing support to students.[18]

Since the development of virtual education, many studies have been conducted on increasing student retention and reducing their academic dropouts, such as the studies on designing a proper educational system, providing the course, and developing the appropriate content.[19-21] Studies have been performed on the challenges of students in virtual education and how to deal with them,[22,23] and studies have also been performed to introduce the SSS in open and distance education.[11,14,24] In this study, researchers tried to identify all the dimensions and components of SSS in virtual education from the birth of the fourth generation of distance education till now as an interrelated whole. Given the importance of the SSS in virtual learning and considering all of its components in the success and self-efficacy of students in virtual education, we performed a scoping review to explore and map the dimensions and components of SSS in virtual learning. It is hoped that the results of this study will help policymakers and planners as well as higher education institutional officials provide virtual education to improve student well-being and success.

Materials and Methods

This proposed scoping review was conducted systematically according to the five-stage methodological framework derived by Arksey and O'Malley for conducting scoping reviews, namely, (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarizing, and reporting the results, with an additional optional stage, consultation.[25] The review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist[26] and Joanna Briggs Institute (JBI) Reviewers' Manual.[27]

Stage 1: Identifying the research question (s)

According to the aim of this study, the following research questions were formulated to guide our search and enable us to capture sufficient literature for this scoping review:

1- Identify the dimensions of the SSS in virtual education?
2- Identify the components of the SSS in virtual education?

Stage 2: Identifying relevant studies

The following databases and search engines were used in the review: MEDLINE (through PubMed), EMBASE, Scopus, WoS, CINAHL, ERIC, PsycINFO, ProQuest, and Google Scholar. The articles were published in renowned medical education journals, including Medical Education, Medical Teacher, and Academic Medicine, and the reference lists of identified and reviewed articles were searched manually for a comprehensive search. The key search terms included (mentor* OR mentee* OR counsel* OR supervise* OR coach* OR consult* OR

preceptor* OR "support system" OR "support service"), and using the term AND combined with (online OR distance OR web-based OR internet-based OR virtual OR blended OR technology-enhanced OR learning OR education OR teaching OR training OR instruction OR curriculum OR university) AND (student* OR trainee* OR learner*). The review of the literature was completed in September 2022. A librarian with relevant knowledge conducted all searches in databases and managed records and data throughout the review. Our search strategy is provided in Table 1.

Stage 3: Study selection

We completed the search and imported all studies into EndNote X20, and duplicates were removed. Two independent reviewers, who were blind to each other's decision, simultaneously screened titles, abstracts, and full papers according to the inclusion and exclusion criteria. A third reviewer resolved any inconsistency between reviewers through discussion. The additional articles were identified through a review of the reference lists of each article. The entire process of article selection will be shown in a

Table 1: Database search strategy and number of retrieved studies

Ovid MEDLINE: Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE® Daily and Ovid MEDLINE® 1946-Present		
1	(mentor* OR mentee* OR Counsel* OR supervis* OR Coach* OR consult* OR preceptor* OR "support system" OR "support service").mp. OR (exp mentors/OR exp mentoring/OR exp counseling/OR exp consultants/OR exp preceptorship/)	499251
2	((online OR distance OR web-based OR internet-based OR virtual OR blended OR technology-enhanced) adj3 (learning OR education OR teaching OR training or instruction OR curriculum OR university)).mp. OR exp Education, Distance/OR e-learning.mp.	25911
3	(student* OR trainee* OR learner*).mp. OR exp students/	412292
4	1 And 2 And 3	1214
EMBASE		
1	mentor*:ab, ti OR mentee*:ab, ti OR counsel*:ab, ti OR supervis*:ab, ti OR coach*:ab, ti OR consult*:ab, ti OR preceptor*:ab, ti OR 'support system':ab, ti OR 'support service':ab, ti OR 'mentor'/exp OR 'mentoring'/exp OR 'counseling'/exp OR 'consultation'/exp	733532
2	(((online OR distance OR 'web based' OR 'internet based' OR virtual OR blended OR 'technology enhanced') NEAR/3 (learning OR education OR teaching OR training OR instruction OR curriculum OR university)):ab, ti) OR 'distance learning'/exp OR 'e-learning'/exp OR 'e learning':ab, ti	32165
3	student*:ab, ti OR trainee*:ab, ti OR learner*:ab, ti OR 'student'/exp	574,019
4	1 And 2 And 3	1,771
Scopus		
(TITLE-ABS-KEY (mentor* AND mentee* OR counsel* OR supervis* OR coach* OR consult* OR preceptor* OR "support system" OR "support service") OR INDEXTERMS (mentors OR mentoring OR counseling OR consultants OR preceptorship)) AND ((TITLE-ABS-KEY (online OR distance OR web-based OR internet-based OR virtual OR blended OR technology-enhanced) W/3 (learning OR education OR teaching OR training OR instruction OR curriculum OR university)) OR INDEXTERMS (education AND distance OR e-learning OR "distance learning") OR TITLE-ABS-KEY (e-learning)) AND (TITLE-ABS-KEY (student* OR trainee* OR learner*) OR INDEXTERMS (students OR student))		765
Web of Science core collection		
TS = (mentor* OR mentee* OR Counsel* OR supervis* OR Coach* OR consult* OR preceptor* OR "support system" OR "support service") AND TI = (online OR distance OR web-based OR internet-based OR virtual OR blended OR technology-enhanced) AND TI = (learning OR education OR teaching OR training OR instruction OR curriculum OR university) AND TS = (student* or trainee* or learner*)		1362
CINAHL (EBSCOhost)		
TX (mentor* OR mentee* OR Counsel* OR supervis* OR Coach* OR consult* OR preceptor* OR "support system" OR "support service") AND TI (online OR distance OR web-based OR internet-based OR virtual OR blended OR technology-enhanced) N3 (learning OR education OR teaching OR training OR instruction OR curriculum OR university) AND TX (student* or trainee* or learner*)		299
ERIC (EbscoHost)		
TX (mentor* OR mentee* OR Counsel* OR supervis* OR Coach* OR consult* OR preceptor* OR "support system" OR "support service") AND TI (online OR distance OR web-based OR internet-based OR virtual OR blended OR technology-enhanced) N3 (learning OR education OR teaching OR training OR instruction OR curriculum OR university) AND TX (student* or trainee* or learner*)		699
PsycINFO (EbscoHost)		
TX (mentor* OR mentee* OR Counsel* OR supervis* OR Coach* OR consult* OR preceptor* OR "support system" OR "support service") AND TI (online OR distance OR web-based OR internet-based OR virtual OR blended OR technology-enhanced) N3 (learning OR education OR teaching OR training OR instruction OR curriculum OR university) AND TX (student* or trainee* or learner*)		484
ProQUEST		
(Student* AND support* AND "e-learning" OR "virtual learning" OR "distance learning")		3764
Google Scholar		
Allintitle: "virtual learning" OR "e-learning" OR "distance learning" AND "student support" OR "learner support"		101

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram[26] [Figure 1]. The inclusion and exclusion criteria are available in Table 2. The reason for the inclusion of studies from 1995 was the birth of the fourth generation of distance education and the presence of broadband Internet in delivering courses.[28]

Stage 4: Charting the data

The data were extracted in accordance with the JBI-recommended approach,[27] by two independent researchers, blind to each other's decision. A data extraction tool[25] was developed to record the key information about the source and findings relevant to the review questions through the consensus of the research team. Then, two of the authors independently extracted the information from the first five included studies, to ensure the consistency of their approach, and the data extraction tool was refined through further consensus. In this review, we extracted authors, year and type of publication, location of studies, study population, major of students, study design, aim of study, and dimensions and components of student support for each of the included articles according to the data extraction tool presented in Table 3. Finally, there were a total of 42 retrieved documents identified as relevant to the review questions. These documents are summarized in Additional File 1.

Stage 5: Collating, summarizing, and reporting results

To collate, summarize, and categorize the literature, a descriptive, analytical approach was employed, including

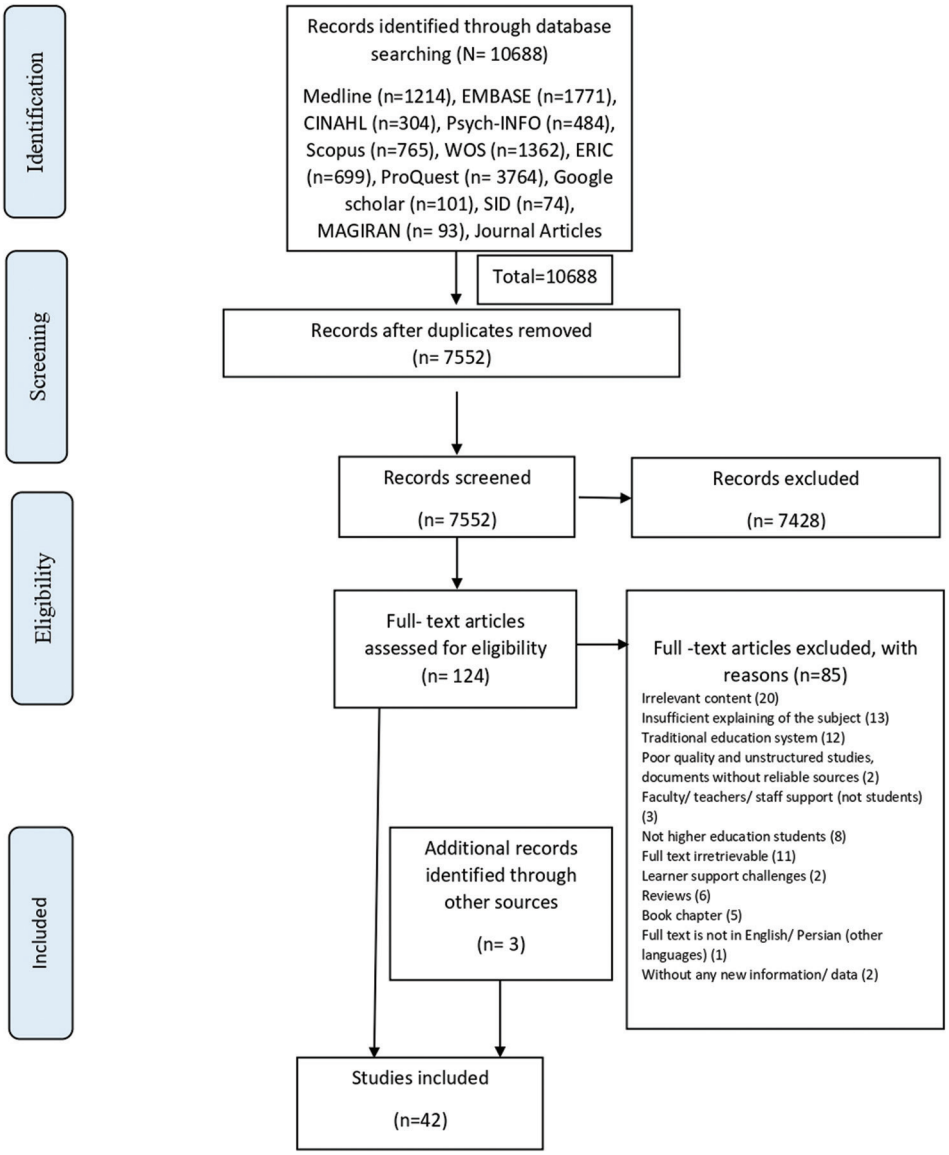

Figure 1: PRISMA-ScR flow diagram indicating the study selection process

a numerical count of study characteristics (quantitative) and template analysis[29] (qualitative).

In the first step, the descriptive data tables were made, and in the second step, the textual data were analyzed using a template analysis approach according to Joanna Brooks.[29] This involved initially familiarizing oneself with the raw data, and then, preliminary coding of the data was carried out and priori themes were used; subsequently, an initial coding template with a hierarchical relationship was defined. Thereafter, the initial template was applied to further data and modified as necessary. A rich and comprehensive representation of interpretation of the data was achieved by an iterative process for modifying and trying again. When the final template was defined, it was applied to the full data set and served as the basis for our interpretation of the data. We applied template analysis after consultation with Professor John Sanders, a well-known medical educationist at Edge Hill University.

Table 2: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
From the beginning of 1995 until December 2022	Outside the mentioned time period
All student support services	Review articles and books
All research designs except reviews	Traditional education
Original research, editorials, conference papers, reports, thesis	Non-higher education
In higher education	Lack of access to the full text of the article
All departments, disciplines, and settings	
In all countries and ethnic groups	
Include all undergraduate and postgraduate programs	
The full text of the article is available	

Table 3: Data extraction tool

ID
First author
Year
Publication
Country
Study population
Health science/non-health science
Study design
Aim of study
Dimensions and components of explored student support service/ systems

Stage 6: Consultation

In forming the initial template and defining the final template, we consulted with Ormond Simpson, a student support and retention specialist at the UK Open University.

Results

The presentation of results is provided in two parts: first, an overview and descriptive summary of the included studies, and second, the analytical summary and formation of the final template.

Part 1—Descriptive summary of the included studies

This review included 42 studies, which were published between 1995 and 2022. A summary of the characteristics of the included studies is presented in Table 4.

Part 2—-Analytical summary of the included studies

The final template consists of five dimensions, namely, (1) types of support, (2) domains of support, (3)

Table 4: Summary of the characteristics of the included studies (*n*=42)

Characteristics of studies	*N* (%)	Characteristics of studies	*N* (%)
Types of publication		Publication year	
Journal article	26 (61.9%)	1995–2000	1 (2.4%)
Report	3 (7.1%)	2001–2005	4 (9.5%)
Conference paper	7 (16.6%)	2006–2010	7 (16.6%)
Doctoral thesis	4 (9.5%)	2011–2015	7 (16.6%)
Master thesis	2 (4.7%)	2016–2020	20 (47.6%)
Location of studies		2021–2022	3 (7.1%)
Asia	9 (21.4%)	Participants' majors	
Europe	11 (26.1%)	Health-related sciences	1 (2.4%)
America	4 (9.5%)	Non-health-related sciences	18 (42.8%)
Africa	18 (42.8%)	Mixed	1 (2.4%)
Oceania	-	No enough data	10 (23.8%)
Study population		Study designs	
University students	26 (61.9%)	Quantitative	7 (16.6%)
University staff, tutors, parents, and others	3 (7.1%)	Qualitative	9 (21.4%)
Mixed	3 (7.1%)	Mixed methods	12 (28.5%)
No enough data	10 (23.8%)	No enough data	14 (33.3%)

stages of support, (4) instigating of support, and (5) levels of support. All dimensions, components, and subcomponents of SSS in virtual learning are presented in Table 5.

1. Types of support

In general, the support needed by students in virtual learning is divided into two general categories: academic or educational support and nonacademic or noneducational support.[10,30-33] Academic support includes the development of general learning skills, teaching, assessment, and feedback, and all activities related to learning, and nonacademic support includes organizational and emotional support.[13] These two types of support are not completely separate, and knowing the skills of each of these dimensions is important to provide effective support.[13]

2. Domains of support

Seven domains of student support in virtual learning were identified in this review: affective support, cognitive support, reflective support, systemic support, human resource support, gender support, and wellness support.

2-1- The affective support helps students stay motivated throughout their studies and includes a variety of services that help students promote personal development at both individual and social levels and consists of social support,[24,34] interactive support,[14,31,33,35-44] practical support,[24] emotional support[10,14,24,31,34,37,39,42,44-51], and assistive support.[14,24]

2-The reflective support develops the capacity to reflect on activities for lifelong learning and guidance for professional and personal development. This domain includes developmental support.[14,39,44,51-53]

3-The cognitive support is aimed at facilitating learning and helps students acquire the necessary knowledge to meet their learning needs.[13,24] Teaching and learning support,[10,14,24,33,34,38,43,46,48,50-56] learning development strategies,[14,44,50,51,53,56] assessment and feedback,[24,31,39,41,46,48,55-58] and library support[10,14,31,33,43,46,50,57] are the components of this support.

4-The systemic support operates through organizational policies and systems for all students and in a customized manner at the individual level. In this area, institutions should provide supportive, inclusive, and user-friendly learning environments for all, regardless of students' status and conditions. Policy support,[14,24,42,51,53] administrative support,[10,14,33,39,42,43,44,47,58] financial support,[14,31,44,46,58,59] management support,[10,14,60,61] legal support,[14,43] and technical support[10,14,42,51,55,57,58,60] are subcomponents of this support.

5-The gender support addresses gender stereotypes and gender inequalities for both men and women, but focuses more on the support needs of women.[24] For example, while both genders may need financial support or flexible payment systems, this may be more important for men than for women, as men are usually the main breadwinners in the family. This area consists of two components of policy and learning environment and building self-confidence.[24]

6-The human resources are always considered one of the most important assets of an organization, and not paying enough attention to it can impose a lot of costs on the organization. This area is one of the most important components of the SSS in virtual learning. It includes three components: teacher support,[10,14,44,46,52,58,60] staff support,[14,52,60,61] and peer support.[44,56,58]

7-The wellness support helps students in facing stressful situations that affect their academic life and includes components of emotional wellness, intellectual wellness, physical wellness, social wellness, occupational wellness, and spiritual wellness.[62]

3. Stages of support

SSS in virtual learning must be available pre-study, during the course, and post-study. Usually, in pre-study and post-study, the support is nonacademic. During the course, support is divided into two interrelated time periods: the beginning of the course in which nonacademic support is dominant and the duration of the course with academic support dominance. The dropout rate is usually much higher at the beginning of the course, and this indicates that the provision of support should be strongly focused at the beginning of a course and even before the course begins.[30,31,33,34,43,47-51,56,57,63-68]

4. Instigator of support

One of the important characteristics of student support is who instigates it and is divided into reactive support and proactive support. Reactive support is initiated by a student who asks for help from the institution, and in proactive support, the institution takes the initiative to contact the student. Reactive support is not often an effective method for student retention.[31,37,39,56,57]

5. Levels of support

The efficiency of support systems requires that services are provided at three levels: individual or micro, institutional or meso, and social or macro.[59] The individual level includes identifying the needs of the student at different stages of study, so that support is provided based on the student's needs at each stage. At the institutional level, by improving cooperative learning skills, communication, and

Table 5: Dimensions, components, and subcomponents of SSS in virtual learning

Dimension 1		
Label	Types of support	
1. Academic		(10, 35, 47, 48, 52, 54, 59, 60, 66)
2. Nonacademic		(10, 35, 47, 48, 52, 54, 59, 60, 66)
Dimension 2		
Label	Domains of support	
1. Affective domain		
1-1- Social support		(24, 55)
1-1-1 Promoting social and cognitive presence		
1-1-2 Holding face-to-face classes or meetings		
Interaction support		(14, 31, 32, 34, 39, 41, 42, 49, 48, 54, 57, 59, 64)
1-2-1- Networking interactions		
1-2-2- Interaction management		
1-2-3- Student organizations		
Practical support		(24)
1-3-1- Preparation for independent and flexible learning		
Emotional support		(10, 14, 24, 30, 33, 34, 40, 41, 46, 47, 48, 50, 55, 57, 64, 67)
1-4-1- Maintaining the learning motivation		
1-4-2- Development of self-identity and responsibility of students		
1-4-3- Psychological counseling		
1-4-4- Personal counseling		
1-4-5- Career counseling		
1-4-6- Administrative consulting		
1-4-7- Cultural support		
Assistive support		(14, 24)
1-5-1- Providing support from the family		
1-5-2- Providing support from the workplace		
1-5-3- Organizing educational programs according to students' family and work duties		
Reflective domain		(14, 36, 41, 51, 64, 67)
Developmental support		
2-1-1- Development of lifelong learning skills		
2-1-2- Development of study skills		
Cognitive domain		
3-1- Teaching and learning support		(10, 14, 24, 33, 34, 36, 45, 46, 50, 51, 54, 55,58, 59, 60, 67, 68)
3-1-1- Environment support		
3-1-2- Resource and content support		
3-1-3-Platform support services		
3-1-4- Facilitating the acquisition of knowledge		
3-1-5- Providing opportunities for further study		
3-1-6- Course-specific online introductions		
3-2- Learning development strategies		(14, 33, 36 60, 64, 67, 68)
3-2-1- Attention to learning style		
3-2-2- Student-centered active learning		
3-2-3- Attention to specific features of the student		
3-2-4- Using space and different educational resources		
3-2-5- Information and logistic systems		
3-3- Assessment and feedback		(24, 33 , 41, 46, 48, 49, 53, 58, 60, 61, 68)
3-3-1- Assessment		
3-3-2- Feedback		
3-4- Library support		(10, 14, 33, 48, 50, 53, 54, 59, 64)
3-4-1- Creating a digital library		
3-4-2- Support of librarians		
3-4-3- Equipping study centers		
Systemic domain		
4-1- Policy support		(14, 24, 51, 57, 67)
4-1-1- Student retention and success programs		

Contd...

Table 5: Contd...

4-1-2- Compliance with quality standards		
4-1-3- Student support management		
4-2- Administrative support		(10, 14, 40, 41, 54, 57, 59, 61, 64)
4-2-1- Registration and administrative processes		
4-2-2- Support for students with special needs		
4-2-3- Database support		
4-3- Financial support		(14, 33, 48, 56, 61, 64)
4-3-1- Teaching economic issues		
4-3-2- Providing financial assistance		
4-3-3- Implementation of a flexible payment system		
4-4- Management support		(10, 14, 38, 37)
4-4-1- Faculty/university vision		
4-4-2- Administrative processes		
4-4-3- Quality improvement programs		
4-5- Legal support		(14, 59)
4-5-1- Ownership and legal rules		
4-5-2- Awareness of the rules		
4-5-3- Dealing with complaints		
4-6- Technical support		(10, 14, 38, 53, 57, 58, 61, 67)
4-6-1- Software technical infrastructure		
4-6-2- Hardware technical infrastructure		
4-6-3- Teaching and responding to students		
5- Gender support domain		(24)
5-1- Policy and learning environment		
5-1-1- Reducing gender discrimination		
5-1-2- Attention to gender differences		
5-1-3- Creating a safe learning environment		
5-2- Creating self-confidence		(24)
5-2-1- Using strategies to increase self-confidence		
5-2-2- Improving technology self-efficacy		
6- Human resources support		
6-1- Teacher support		(10, 14 , 33, 36, 38, 61, 64)
6-1-1- Development of technical skills		
6-1-2- Development of professional performance		
6-1-3- Tutor support		
6-2- Staff support		(14, 36, 37, 38)
6-2-1- Development of technical skills		
6-2-2- Development of response skills		
6-2-3- Increasing the number of employees		
6-3- Peer support		(60, 61, 64)
7-Wellness support		(68)
7-1- Emotional wellness		
7-2- Intellectual wellness		
7-3- Physical wellness		
7-4- Social wellness		
7-5- Occupational wellness		
7-6- Spiritual wellness		
Dimension 3		
Label	Stages of support	
1. Pre-study		(35, 40, 43, 44, 46, 47, 48, 50, 53, 54, 55, 59, 60,62, 63, 67)
2. During study		
2-1- Beginning of the program		
2-2- Moving through the program		
3. Post-study		
Dimension 4		
Label	Instigator of support	

Contd...

Table 5: Contd...

1.	Reactive support	(34, 41, 48, 60, 67)
2.	Proactive support	
Dimension 5		
Label	Levels of support	
1.	Individual level/micro	(56)
2.	Institutional level/meso	
3.	Social level/macro	

socialization processes, learning inequalities are eliminated and group learning is encouraged. At the social level, programs should be considered for cultural sensitivity parameters and social inequalities that exist in students.[59]

Mind map of authors

The five dimensions discussed above have some components for a comprehensive SSS in virtual learning. The components of each dimension were extracted and integrated to form our mind map about SSS in virtual learning. This mind map includes the components of five main dimensions: 1. domains of support, 2. stages of support, 3. types of support, 4. instigator of support, and 5. levels of support.

The first dimension is domains of support. Affective, reflective, cognitive, systemic, gender, human resource, and wellness support are components of domain of support. These components have some subcomponents that were mentioned in the mind map. They are not completely distinct from each other.

The second dimension is stages of support with pre-study, during study, and post-study components. At each stage of support, we have different degrees of components of domains of support.

The third dimension refers to types of support: academic and nonacademic. Academic support is the most prominent type of support during study and in pre-study and post-study stages of nonacademic support if dominant.

The instigator of support is the fourth dimension of support with reactive and proactive components. Proactive support is personalized support, which can lead to student success.

The final domain is levels of support at individual, institutional, and social levels. Support systems should take into account the levels of support from the beginning to the end of the course simultaneously.

The most important aim of support systems is student success, which is in the center of our mind map [Figure 2].

Discussion

This review contributed to the body of evidence of the SSS in virtual learning by mapping the available literature in higher education and successfully providing an insight into the dimensions and components of the subject. Students in virtual education need more support than those in traditional education due to physical separation from the university. Effective SSS is an important tool for enabling students to cope with the pressures of distance learning. Student satisfaction helps attract new students, retain current students, improve their overall performance, and increase student achievement.[31] Forty-two studies were included in this review, and five dimensions and their related components were extracted.

The key findings of this review are as follows:

1- Types of support: academic and nonacademic
2- Domains of support: affective support, cognitive support, reflective support, systemic support, human resource support, gender support, and wellness support.
3- Stages of support: pre-study, during the course, and post-study.
4- Instigator of support: started by the institution is proactive, and asked by the student is reactive.
5- Levels of support: individual or micro, institutional or meso, and social or macro.

The ensuing paragraphs try to interpret the above findings in the context of the present literature.

Types of support

Many studies mentioned different types of support. Academic support deals with all learning activities and counseling, orientation with college and university, and helping students in registration, and all the related matters are examples of nonacademic support.[10,30-33,43,49,56,67,68]

Domains of support

In affective support networking interactions at different levels of student with students and teachers,[14,31,33,35,36,38-40,43,44] orientation weekend,[37,39,41,44] student organizations,[33] psychological counseling,[14,45,46] personal counseling,[44] career counseling,[44] and administrative–academic counseling[14,39,47,50] were prominent in the studies.

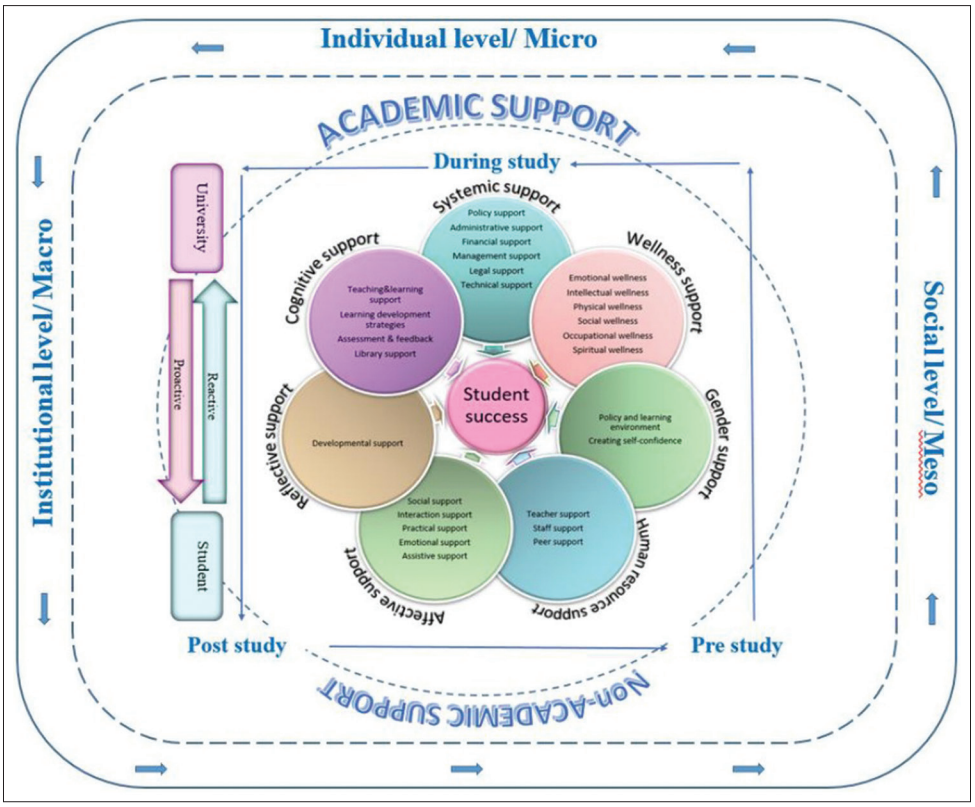

Figure 2: Mind map of student support systems in virtual learning according to this review's findings

Many studies mention cognitive support as the main part of academic support. The identification of at-risk students to devote infrequent support resources and predicting the probability of student's success by learning analytics are a significant matter that only Simpson mentioned in his study,[56] and paying attention to this matter is recommended.

Only one study addressed the gender support needs of students in virtual education, and while considering the cultural background of many countries in the world, especially in Asian countries, it seems more important to pay attention to this issue.[57]

Wellness support is another debatable issue that only one study mentioned this matter.[62] We could see some subcomponents in other dimensions that were related to emotional wellness, intellectual wellness, social wellness, and occupational wellness, but physical wellness, which recommends regular physical activity to achieve physical health, and spiritual wellness to search for meaning and purpose are in human existence that was not mentioned anywhere. Thus, dealing with these two is emphasized.[62]

Stages of support

In the pre-study stage, besides providing general information about the program, its duration, registration, and assessing students' previous knowledge, studies recommended university, campus-wide, and course-specific online orientation.[30,33,51,56,64] During the course, the support is divided into two interrelated time periods, in the beginning of the course orientation with doing homework, accessing to learning resources, introducing assessment and exam criteria is considered in many studies[34,48,63,64,66] and in moving through courses most provided supports are academic.[64,31,57,66] In the course completion stage, studies mentioned career empowering, developmental counseling, and providing more educational opportunities.[30,63,65,66,51]

Instigator of support

In this domain, we have reactive support and proactive support. The difference between them is in the initiator of providing support, either the student contacts the institution asking for support or the institution contacts the student to provide support in a personalized manner. Effective student retention services must be provided in the form of timely interventions, and proactive support can have a significant impact on student retention and success.[56] It is a very important matter that only one study is discussed[56] and more study is recommended.

Levels of support

Micro or individual, meso or institutional, and macro or social support were identified as the levels of support

Additional File 1: Summaries of included studies according to data extraction tool

No	Authors	Year	Publication	Country	Study population	Health sciences/ Non-health sciences	Study design	Sampling method
1	M. Mohammadimehr Z. Mirmoghtadaie (15)	2021	Journal article	Iran	e-learning experts and specialists of universities of medical sciences	Health sciences	Qualitative	Purposive
2	A. Askar, A. Adawiyah And N. Nurdin (45)	2021	Journal article	Indonesia	university students	Non-health sciences	Qualitative	Purposive
3	C. Chaka, T. Nkhobo And M. Lephalala (35)	2020	Journal article	South Africa	university students	Non-health sciences	Qualitative	volunteer sampling
4	C. Andrade, P. Alves, J. E. Fernandes And F. Coutinho (36)	2020	Conference paper	Portugal	Not stated	Not stated	Not stated	Not stated
5	R. S. Netanda, J. Mamabolo and M. Themane (46)	2019	Journal article	South Africa	university students	Non-health sciences	Mixed method	Purposive
6	B. Halkic and P. Arnold (37)	2019	Journal article	Germany	university students	Not stated	Mixed method	Purposive/ Convenience sampling
7	A. Walters-Archie (30)	2018	Journal article	Jamaica	university students	Non-health sciences	Mixed method	Not stated
8	Fengling Zhou , Chengling Zhao, Zhihui Jiang, Lu Wang (52)	2017	Conference paper	China	Not stated	Not stated	Not stated	Not stated
9	Dr. Asteria Nsamba Dr. Mpine Makoe (61)	2017	Journal article	South Africa	University students	Not stated	Qualitative	Purposive
10	L. Y. Chen (60)	2016	Conference paper	China	Not stated	Not stated	Not stated	Not stated
11	Frank Boyle A , Jinhee Kwon B , Catherine Ross C & Ormond Simpson (38)	2010	Journal article	UK	University students	Not stated	Quantitative	Census
12	Aminudin Zuhairi Irma Adnan Dina Thaib (47)	2007	Journal article	Indonesia	University students	Non health sciences	Quantitative	Not stated
13	Linda Dowling And Orna Ryan (39)	2007	Report (case study of Dublin)	Ireland	University students	Non health science and health science	Not stated	Not stated
14	H. J. Zhang and K. C. Almeroth (40)	2004	Conference paper	USA	University students	Non-health science (Department of Computer Science)	Not stated	Not stated
15	Judith Potter (63)	1998	Journal article	Canada	University students	Non-health science	Quantitative	Convenience sampling
16	Akwasi Arko-Achemfuor (64)	2017	Journal article	South Africa	University students	Non-health science	Mixed methods	stratified random sample
17	Ndhlovu D (54)	2018	Journal article	Zambia	University students	Non health science (Master in Education Management)	Qualitative with an Ethnographic design	purposively sampled due to their active engagement
18	Omer Hassan Abdelrahman (48)	2012	Journal article	Khartoum, Sudan	University students	Non health science	Qualitative	Purposively
19	Latika Kumari Mishra (49)	2014	Journal article	India	University students	Not stated	Not stated	Not stated

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Additional File 1: Contd...

No	Authors	Year	Publication	Country	Study population	Health sciences/ Non-health sciences	Study design	Sampling method
20	Cletus Kolog Ngaaso (31)	2016	Journal article	Ghana	University students	Non-health sciences (University of Education)	Quantitative	Census
21	Ndinomayele Diina Haufiku (41)	2010	Journal article	Namibia	Students, tutors and parents	Not stated	Not stated	criterion sampling (all students that study at NAMCOL, tutors at the center and parents with children at the centers.)
22	Gloria C. Alaneme & Peter O. Olayiwola (50)	2010	Journal article	Nigeria	University students	Not stated	Quantitative	Not stated
23	Alan Tait (53)	2010	Journal article	UK	Not stated	Not stated	Not stated	Not stated
24	Angeles Sánchez-Elvira Paniagua (32)	2018	Journal article	the European Association of Distance Teaching Universities (EADTU)	European Distance Teaching Universities	Not stated	Not stated	Not stated
25	Insung Jung (24)	2014	Journal article	Korea	Japan, Korea, Hong Kong SAR China, Malaysia, India, Pakistan, Philippines, Singapore, and Thailand's DE in universities	Not stated	qualitative	Census sampling in Japan, Korea, Hong Kong SAR China, Malaysia, India, Pakistan, Philippines, Singapore, and Thailand's distance university students
26	Sougata Chattopadhyay (57)	2014	Journal article	India	Not stated	Not stated	Not stated	Not stated
27	Barbara L. Stewart (33)	2013	Journal article	USA	Not stated	Not stated	Not stated	Not stated
28	MURAT Ozoglu (34)	2010	Journal article	Turkey	institutional representatives/ University students	Not stated	Mixed method	Purposive/census
29	Lukas Shikulo (10)	2020	Doctoral thesis	Namibia	University student/regional coordinators (RCs)	University of Science and Technology	mixed methods approach (QUAL+quan approach categorized as an exploratory design)	Stratified random sampling was used to select the number of students/The RCs were purposively selected
30	Antonis Lionarakis (59)	2018	Conference paper	Greece	Not stated	Not stated	Not stated	Not stated
31	Angelo Fynn (42)	2017	Journal article	South Africa	University student	Non- health science (MA psychology)	Quantitative	Census
32	Greig Krull (55)	2018	Conference paper	Spain	University students	Non health science (Art & science)	Mixed method	Census samplin/ Random sampling for interview
33	Jamiah Mayanja (43)	2019	Journal article	Uganda	University students/Student leaders and staff members	Not stated	mixed method approach involving descriptive statistics and case study research design.	Randomized Sampling of students/purposive sampling of Student leaders and staff members

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Additional File 1: Contd...

No	Authors	Year	Publication	Country	Study population	Health sciences/ Non-health sciences	Study design	Sampling method
34	Ormond Simpson (56)	2016	report	UK	Not stated	Not stated	Not stated	Not stated
35	Kaudo, Isdore O (58)	2018	MA Thesis	Nairobi	University students (bachor of education)	Non –health sciences (bachelor of education)	Mixed method	Cluster sampling
36	Gearoid Kenny (65)	2003	Conference paper	Ireland	University students	Not stated	Qualitative/ Case study	Not stated
37	DELVALINE LUCIA Möwes (66)	2005	Doctoral thesis	NAMIBIA	University students (Bachelor of Education)	Non-health science	Mixed method	random sampling
38	Melanie M. Washington (44)	2021	Doctoral thesis	USA	University of Louisiana students	Not stated	the sequential explanatory mixed methods	Cluster sampling/
39	TSIGE GEBREMESKEL ABERRA (68)	2016	Doctoral thesis	Ethiopia	doctoral students of UNISA	Not stated	Qualitative	convenience sampling
40	Mphoe-Entle Puleng Modise (67)	2015	MA thesis	South africa	academic staff members	Non health sciences	mixed method	convenience sampling/Purposive sampling
41	Alan Tait (51)	2015	Report	UK	Not stated	Not stated	Not stated	Not stated
42	Stephanie B. (62)	2003	Journal article	USA	University students	Masters program in arts and sciences	Quantitative	Not stated

No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
1	Thematic Content Analysis by AttrideStirling method	semistructured interview	Exploring the component of SSS in blended learning	Scientificcognitive support (Content of curriculum/Learning strategies/Evaluation/Library support/Educational wellbeing) Systematic support (Support systematic model/Administrative support/Management support/Legal support) Human resource support (Teacher support/Staff support/ Interactive support) Emotional support (Psychocognitive support/Advisory support/ Cultural support) Technical support (Technical infrastructure/Physical support) Financialeconomic support (Economical education/Financial support)
2	grounded theory approach as outlined by Strauss and Corbin	In-depth interview	Exploring the role of academic advising support in order to reduce stress and promote students' mental health.	Psychological support in online learning
3	Content Analysis	Questionnaire Interview	Integration two instant messaging applications (Moya Messenger App and WhatsApp) and a myUnisa's online discussion forum (ODF) as tools to support student learning at ODL	use of social media and discussion forum to support students in an open and distance learning
4	Not stated	Not stated	e-mentoring and support student's integration and reduce the risk of drop put in e-learning	e-mentoring
5	Content Analysis/ analytic statistics	Questionnaire unstructured in-depth interviews	to examine whether there is a link between student support intervention and student retention as well as between student support and student success	Financial support Academic support Technical support Emotional support

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Additional File 1: Contd...

No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
6	Content Analysis/ analytic atatistics	Questionnaire unstructured in-depth interviews	To explore student perspectives on need and support in the context of (online) higher education	Online tutorials Study or orientation weekend Online mentoring Career mentoring Buddy programme Counselling Help desk Student forum Study groups Newsletter
7	Not stated	questionnaires	to share the intervening conditions influencing academic support strategies that are utilised by the team in the UWIOC's Programme Delivery Department as well as the results of the survey which is expected to indicate if the students are finding these academic support services useful and beneficial.	Types of support: Non-academic/Non- instructional Academic/Instructional Pre-course for non-instructional In-course for academic or instructional Post-course for non-instructional
8	Not stated	Not stated	Five-dimensional learning support service system of blended learning	Resource support services (books resources, physical resources and online digital media resources and text resources, image resources, video resources and animation resources Environment support service (network virtual learning environment such as Internet, telecommunications networks, satellite networks and it realizes the combination of real-time and non-realtime) (classroom physical environment includes the face-to-face classroom, computer room, laboratory and other campus environment) Personnel support service (online teachers, peers, experts) (off line teachers, peers) Teaching methods support service (learning in the classroom) (online learning) Platform support service (network teaching platform) (virtual simulation lab)
9	Braun and Clarke's (2006) six-step guidelines of thematic data analysis	In-depth semi structured interview	to evaluate the quality of support services from the current users of the services	Support service quality in distance education can be measured by six dimensions namely; tangibles, reliability, responsiveness, delivery, assurance and student participation. Each dimension can be measured by a number of attributes
10	Not stated	Not stated	To analyze the factors affecting the distance education supporting system	Composition of distance education Supporting service system: Hardware part Software part Personnel section
11	Descriptive and analytic statistics by SPSS	questionnaire	reports on three student–student mentoring initiatives in the Open University UK (OU UK), the Korean National Open University (KNOU), and the Open Polytechnic of New Zealand (OPNZ)	student–student mentoring peer support

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No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
12	Not stated	Not stated	the practice and experience of Universitas Terbuka (UT) in the provision of learning support services for students in a large-scale distance education system	Student learning support system includes services such as: Tutorial academic advising and counselling study group activity academic administration services for students organisation of student activities
13	Not stated	Not stated	how the features of effective learner support have been implemented by University College Dublin (UCD) in the case of its distance learning business degree programme	The five central features of the Learner Support Framework are: Day-to-Day Learner Support Feedback and Learner Progress Study Skills Development Induction and Learner Integration Personal Tutors
14	Not stated	Not stated	To identify the features and requirements of a remote TA support system and plan a set of phases to develop the system.	Remote TA support system
15	Descriptive & analythic statistics	Questionnaire	To assess support service needs and assessments of distance learners at three Canadian bi-modal universities	Stages of support need: Pre-enrolment Starting courses/program Moving through program Moving on
16	Content analysis/ descriptive statistics	mixed-methods approach using a focus group and a set of questionnaires	to solicit the views and experiences of students on the challenges they face in accessing the support services the university offers	General information on recruitment and enrolment General assistance on studies Materials Concerns Financials Tutorials Technical services myUnisa Assignments
17	Inductive content analysis	In depth interview	To document the use of “WhatsApp” as a tool for learner support among postgraduate students on the distance learning mode	Learner support tool: Whats app
18	content Analysis/ Analytic and descriptive data analysis	Structured interview, document analysis, and website survey	investigates the library and information services support available to distance learners in Sudan	Library support • digital/virtual reference services; • information service through email; • access to powerful search tools to retrieve the whole or part of a digital document Skill support • help in the use of databases • help in finding relevant information on the Internet

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Additional File 1: Contd...

No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
19	Not stated	Not stated	to study the role of academic counselling in distance education system	Stages of LSS: • Pre-entry stage • During the course of studies • At the course completion stage Types of support: • Self instructional learning materials • Academic support services • Assignments • Media and technology • Academic counselling Media of Counselling in Open and Distance Learning: 1. Face to face counselling 2. Counselling through Assignments 3. Counselling through Telephones 4. Counselling through Letters 5. Counselling through Internet 6. Counselling through Broadcasting (Radio/Television) 7. Counselling through Self Instructional Materials
20	descriptive and multivariate statistical methods	questionnaire	To investigate students' level of satisfaction of the support services provided them by the University	Types of support: • Academic support • Non-academic support Supports needed: • Feedback to students • tutor-student interaction • library services • Face-to-face tutorials • Relevant Assignment • Clear Evaluation Procedures • Instructor's Encouragement • Readiness of Help Desk Staff • Orientation Activities • Admission Procedures • Punctuality of Instructors • Instructor Inform Progress of Work
21	Not stated	Questionnaire semi- structured interviews focus group discussions participatory experience observation checklists and documentary checklists	to review and determine the applications and important problems of the learner support services and systems and present a number of suggestions to enhance learner support in the Namibian distance education system	• First category of support includes all activities beyond the production and the delivery of course materials that assist in the progress of learners in their studies • The second category of the learners' support is non-academic – the support of learners in the effective and organizational aspects of their studies • The third category is Continuous Assessment and Feedback
22	Descriptive analysis	questionnaire	determining what support services are existent in each of the dual-mode universities in Nigeria	Support Services Provided by Universities: • Library Support and Study Material • Assignments and Personal Contact Programme • Guidance & Counseling

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Additional File 1: Contd...

No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
23	Not stated	Not stated	examines the various factors that need to be taken into account in the planning of student support in open and distance learning systems	The primary functions of student support: • Cognitive • Affective • Systemic Support services for students: 1. enquiry, admission and pre-study advisory services; 2. tutoring; 3. guidance and counselling services; 4. assessment of prior learning and credit transfer; 5. study and examination centres; 6. residential schools; 7. library services; 8. individualised correspondence teaching, including in some cases continuous assessment; 9. record keeping, information management, and other administrative systems; 10. differentiated services for students with special needs of one sort or another, e.g., disability, geographical remoteness, prisoners; and 11. materials which support the development of study skills, programme planning or career development. Framework for the development of a planning tool for student support services, six core elemens: Course or programme demands Geography • Management system • Scale • Technological infrastructure • Student cohort characteristics
24	Not stated	Not stated	To share expertise of distance education universities in student support services	Types of support: • Proactive • Reactive Student support can be the academic kind or the non-academic: Academic. This is aimed at developing a student's cognitive and learning skills – in other words teaching or tuition. Non-academic. This is aimed at developing a student's organisational and affective skills
25	Content analysis	online survey included three open questions	To identify the key concerns of Asian DE students regarding support provision in different types of DE and dual-mode providers and formulate a student support model	in assessing the quality of DE the students valued 13 types of student support across five domains: affective, reflective, cognitive, systemic, and gender-considerate It was also confirmed that there were gender differences in the students' perceptions of the need for student support

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Additional File 1: Contd...

No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
26	Not stated	Not stated	analyzes the aim of learner support services, various categories of learner support services, how far Indira Gandhi National Open University (IGNOU) has providing interactive support services at the study centres, staff responsibility for providing the services, ICT facilities and equipment at the study centres, mode of service delivery and monitoring mechanism to ensure effective student support services	Category of the Support Services: • Pre-Admission services • Information services Post –Admission services: Self learning material dispatch Examination and evaluation services Library services Financial support Technological support Electronic media services Additional support services
27	Not stated	Not stated	This paper is based on the authors' perceptions and experience that support is important for student success	This case indicated a primary need and provisions for student support in the following areas: admissions and registration, advising, orientation, learning support, scholarships and awards, library resources, computing and technology resources, articulation with other institutions, career placement, and communication.
28	Content analysis/ descriptive statistics	Questionnaire/ investigation of institutional artifacts, and interviews with the institutional representatives.	To examine the support service needs and preferences of distance learners studying at the Turkish Open Education System	The functional support service categories suggested by Tait (2000): cognitive (academic), affective (emotional), and systemic (administrative).
29	Descriptive and analythic statistics/ content analysis	Questionnaire/ semi-structured interviews	This research explored the implementation of SSS at eight regional centres of the Namibia University of Science and Technology, in order to identify the challenges experienced and determine students' needs	Student support services at COLL Regional Centres: Increasing staff members Student empowerment Improvement of regional centre infrastructure Quality improvement Provision of formative feedback Enhancing collaboration
30	Not stated	Not stated	The purpose of this article is to summarize the context of the ongoing research effort of the PENER-16 program of the Hellenic Open University (EAP), emphasizing the need to develop an integrated student support system in the learning community of a distance learning tertiary institution	Levels of student support: • Individual (Micro level) • Institutional (Meso level) • Societal (Macro level) The Micro: The importance of pre-entry & ongoing individual support The Meso: Creating a supportive institutional community The Macro: Culturally sensitive learning in a distance-shrinking world

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No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
31	Descriptive statistics	Online questionnaire	To provide a studentsupport framework that may identify the support needs and support sources to improve postgraduate student support	Framework for non-academic support: • Emotional support Entry into community of practice Mentoring Emotional support Intraction with peers • Cognitive support Technical research skill/functional support Expert advice Enculturation into discipline • Administrative support Financial support Access to academic resources Study or writing space Technological infrastructure Recruitment & admission
32	Analysis of the quantitative surveys was done via descriptive analysis, while the analysis of the qualitative interviews was done using a grounded theory approach.	online survey and follow-up semi-structured interviews	This study investigates the academic and technological support needs of ODL university students	Academic and technological support
33	Not stated	self-administered questionnaires and individual interviews	to investigate the use of ICTs in student support in ODL at Makerere University.	Academic support suggestions: Explanatory tutorial videos Synchronous video conferencing or chats More personalised assessment feedback Subscription to alerts or notifications More use of audio-visual materials Communication Improvement Explanatory tutorial videos Assessment Feedback Improvement Synchronous Video Conferencing or Chats More use of audio-visual materials Technological Support suggestions: mobile app improvements Better support for using devices and tools Digital skills courses Internet Accessibility and Costs Discounted Rates for Devices and Tools Creation of a Mobile App Teaching and Learning Processes Students are provided log-ins to access student portal Course materials are available on the learning management system Students access results online There is an online library for students Timetables for lecturers and exams are displayed online Projectors and microphone are used during lectures Students interact with lecturers/tutors via e-mail and SMS

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Additional File 1: Contd...

No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
				Computer labs are adequately equipped There is free internet connectivity while at the university Students receive learning support through e-mail, SMS and forums Social media is used to communicate with students Students complaints are received and handled online and via phone Students interact with each on social media
34	Not stated	Not stated	To introduce types of student support for ODL students	Types of support: Cognitive support Emotional support Organizing support Active support Reactive support Academic support: Teaching Developing learning skills Assessment and feedback Non academic support: Organizational support Emotional support Timing of support Media for support
35	Descriptive statistics through SPSS	Questionnaire with open and close ended questions	To examine the influence of learner support services on learners retention in bachelor of education students by ODEL	Types of support: Administrative support Guidance & councelling Peer support services Tutorial support Technological support
36	Not stated	Not stated	to analyse student support services in elearning as offered by Ericsson Education in the form of their Ericsson Education Online solution	Supports according to different phase of e-larning: Information Phase Guidance phase/registration phase Integration/help desk/final results phase Learning phase
37	Descriptive and analythic analysis/content analysis	questionnaire/open ended questions	To explain the need and importance of student support services for the facilitation of each student's full development and the provision of quality distance education	types of support services provided to distance education students through various stages of their study: The pre-entry stage • guidance about the types of programmes and courses available • pre-admission counselling with regard to selection of courses; • information regarding the instructional system, entry • requirements, fee structure, duration of the programme of study and recognition of prior learning • advice regarding fee reimbursement and fee concessions The course stage • An induction/orientation into the instructional system of the organisation; • Distribution of self-instructional materials and assignments; • Provision of television programmes, radio broadcasts, teleconferencing, and the schedules thereof; • Provision of library facilities;

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Additional File 1: Contd...

No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
				• Organisation of experiential learning, practicals at science laboratories, computer laboratories and industry; • Organisation of assignment evaluation and feedback through tutor comments; • Development of study skills, time management and structuring of the learning process; • Provision of counselling and tutoring services (including face-to face tutorials and schedules thereof); • Admission and assessment criteria and examination procedures; • Communication of results of assessment • Provision of relevant, accurate and unbiased information The post-course stage • communication of final results/grades/awards; • advice regarding career advancement/job opportunities/ future prospects • guidance and developmental counselling with respect to reregistration in case of failure
38	Descriptive analysis/content analysis	Oline questionnaire	to determine what is known about the influence of participation in TRIO – Student Support Services	The SSS services fall into four categories: Academic instruction • offer academic instruction for students with limited proficiency in math, English and…. Academic support • Peer tutoring • Professional tutoring • Supplemental instruction • Assisted labs • Computer-assisted instruction • Study skills classes/workshops • Orientation classes/workshops Counseling and mentoring • Personal counseling • Academic advising • Financial aid counseling • Career counseling and employment assistance • Transfer counseling • Graduate school counseling • Professional mentoring • Peer counseling/mentoring Cultural and enrichment activities • Cultural activities • Campus visitations • Information workshops
39	Descriptive and analytic analysis/ Cohen's kappa, Cronbach's alpha, a t-test and regression analysis	questionnaire	to determine the quality of support services provided by UNISA to doctoral ODL students based in Ethiopia	Dimensions of SSS: • Supervision support • Infrastructure • Administrative support • Academic facilitation

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Additional File 1: Contd...

No	Data analysis	Data collection	Focus/aim of the study	Dimensions & components of explored student support service/systems
40	descriptive statistics/ content analysis	Questionnaires/ interviews	To explore and study how educators' skills, knowledge and experience in e-learning and how the design of a quality support system in an ODL and e-learning environment in a developing country can contribute to the successful achievement of the institution and student's educational goals.	Academic skills • Assessment skills • Subject knowledge • Presentation skills • Exposition skills Non-academic skills • Listening skills • Empathy • Stress management skills
41	Not stated	Not stated	To identify current best practice in SSS strategies for improving student success	a number of key elements that support practice for student success: • pre-study information, advice, guidance and admission • curriculum or programme design for student success • intervention at key points and in response to student need • assessment to support learning as well as to judge achievement • individualised and personalised systems of support to students • information and logistical systems that communicate between all relevant participants in • the system • managing for student success
42	Descriptive and analytic statistics by SPSS	questionnaire	to determine which student support service resources should be included in an Online Wellness Resource Center (OWRC) available within an online course	Dimensions of wellness: • Emotional wellness • Intellectual wellness • Physical wellness • Social wellness • Occupational wellness • Spiritual wellness

in this study that only were mentioned in Lionarakis' study.[59] Thus, to provide an effective and efficient SSS, considering these levels in more studies is recommended.

Strikingly, most studies (94%) were conducted on non-health-related professional students and only 6% of studies were conducted on students of health professions. Meanwhile, the support needs of virtual education students in fields related to health sciences are much higher due to their clinical training.[63] In this regard, more studies on health professional students are recommended.

In most of the studies, there was no clear distinguishing information about a student's degree, while it is usually expected that the needs of students of different levels of education are different and undergraduate students who enter higher education directly from high school may have more support needs.[62] It is suggested to carry out more research separately on undergraduate, master's, and doctoral students.

In more than half of the studies, the study population was students, and few studies were conducted on university professors and staff. Considering the extent of students' support needs in virtual education and the understanding of some of these needs by employees who directly or indirectly deal with students,[39] it is suggested to conduct more research on populations including academic staff, technical staff, and counseling staff.

Conducting further research on the following matters in SSS in virtual learning is recommended:

- SSS in health professional students
- Academic staff, technical staff, and counseling staff
- Separately on undergraduate, master's, and doctoral students
- Support needs of different gender groups in the context of virtual education
- Dealing with physical wellness and spiritual wellness.

Limitations

The full text of some articles was not available, but the researcher contacted those article's authors and most of them were received. Only English and Persian articles were included in the study.

Conclusion

The findings of this review will be an important contribution to the body of knowledge about SSS in

virtual learning. The dimensions and components extracted in this study are the most important factors for student success that have not been introduced as a whole in other studies. Therefore, we depicted a comprehensive SSS mind map in virtual learning that includes dimensions and components of SSS in virtual learning. According to our findings, the SSS should be viewed as an interrelated whole. Addressing each dimension without considering the other dimensions will lead to the failure of this system.

Paying attention to the findings of this study is a guide for system developers and planners to improve the quality of virtual learning and also provides a road map for higher education institutions offering virtual education to improve the quality of virtual education and ensure the attraction and success of students. Finally, the knowledge gaps identified in this study can be researched by interested investigators.

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Conflicts of interest

There are no conflicts of interest.

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