Mining and metallurgy Institute named after O.A.Baikonurov

Mining Department

EDUCATIONAL PROGRAM

8D07211- " Digital modelling of mining and geomechanical processes "

Code and classification of the field of education:	8D07 – Engineering, manufacturing and construction industries
Code and classification of training directions:	8D072 – Manufacturing and processing industries
Group of educational programs:	D116 – Mining and mineral extraction
Level based on NQF:	8
Level based on IQF:	8
Study period:	3 years
Amount of credits:	180

Almaty 2025

Educational program 8D07211- " Digital modelling of mining and geomechanical processes " was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Minutes № 10 dated « 06 » March 2025.

Was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council

Minutes № 3 dated «_22_» _December _2024 .

Educational program 8D07211- " Digital modelling of mining and geomechanical processes" was developed by Academic committee based on direction 8D072- «Manufacturing and processing industries »

Full name	Academic degree/academic title	Post	Place of work	Signature
Chatiman of the Academic Committee:				
Moldabayev Serik	Doctor of Technical Sciences, Professor	Head of the Department	KazNRTU named after K.I. Satpayev	
Teaching staff:				
Yusupov Kh.	Doctor of Technical Sciences, Professor	Professor	KazNRTU named after K.I. Satpayev	
Sandibekov Manarbek	Candidate of Technical Sciences, Associate Professor	Professor	KazNRTU named after K.I. Satpayev	
Employers:				
Uteshov Y.	PhD doctor	Director	IGD named after D.A. Kunaeva	
Amankulov Maksat	Master of Engineering sciences	Executive Director	Antal LLP	
Orynbayev Baurzhan	PhD doctor	Head of the BVR Parameters Department	NPP Interrin LLP	
Gryaznov V.	Master of Engineering sciences	Head of the Mining Department	Antal LLP	
Students:				
Tilektes Ayaulym		3rd year student		
Karsibekov Magzhan		2nd year Master 's student		
Assylkhanova Gulnur	Master of Engineering sciences	3rd year doctoral student		

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List of abbreviations and designations

NJSC ‘Kazakh National Research Technical University named after K.I. Satpayev’ - NJSC (non-profit joint stock company) KazNITU named after K.I. Satpayev;

SOSE - State obligatory standard of education of the Republic of Kazakhstan;

MES RK - Ministry of Education and Science of the Republic of Kazakhstan;

EP - educational programme;

IWS - independent work of a student (student, master's student, doctoral student);

IWST - independent work of a student with a teacher (independent work of a student (master's student, doctoral student) with a teacher);

WSP - work study plan;

CED - catalogue of elective disciplines;

UC - university component;

EC - elective component;

NQF - national qualifications framework;

NQF - national qualifications framework; SQF - sectoral qualifications framework;

LO - learning outcomes;

KC - key competences.

1. Description of educational program

The educational programme of doctoral training by profile is aimed at the introduction of the mechanism of training of 'industrial doctor of sciences' together with large industrial companies, has a scientific orientation and assumes fundamental methodological and research training and in-depth study of disciplines in relevant areas of science for the system of higher and postgraduate education and scientific sphere. The educational programme of doctoral training by profile assumes fundamental educational, methodological, research training and in-depth study of disciplines in the relevant areas of science for the branches of national economy, social sphere: economics, business administration. Educational programmes of doctoral studies in the part of professional training are developed on the basis of studying the experience of foreign universities and research centres implementing accredited programmes of doctoral training by profile. The content of the educational programme of the profile doctoral studies is established by the higher education institution independently.

The main criterion for the completion of the educational process of doctoral training in the profile is the mastering by the doctoral student of at least 180 academic credits, including all types of educational and research activities. The duration of doctoral studies is determined by the volume of academic credits mastered. When the established volume of academic credits is mastered and the expected learning outcomes for obtaining the degree of doctor in the profile of the educational programme of doctoral studies are achieved, the educational programme of doctoral studies is considered fully mastered.

The content of the educational programme of doctoral studies consists of:

1) theoretical training, including the study of cycles of basic and specialised disciplines;

2) practical training of doctoral students: various types of practical training, scientific or professional internships;

3) research work, including the performance and defence of a doctoral dissertation on the profile;

4) final certification.

Possibility to choose disciplines from the catalogue of elective disciplines of Satbayev University.

Training of personnel in the profile doctoral studies is carried out on the basis of educational programmes of doctoral studies in the profile direction with a study period of not less than three years.

The content of the OP 'Digital modelling of mining and geomechanical processes' on the basis of the development of a multilevel system of training, fundamental and quality of education, continuity and continuity of education and science, the unity of education, upbringing, research and innovation activities, aimed at maximum satisfaction of consumer demands should provide:

- obtaining a full-fledged and quality professional education in the field of mineral deposits development (MPI), confirmed by the level of knowledge and skills, skills and competences, based on the criteria established by the State General

Education Standard, their assessment, both in content and volume:

- preparation of professional and competitive specialists in the field of development of MPI and creation of new technologies of mining production and production management;
- use of methods for analysing and evaluating the results of experiments.

2. Purpose and objectives of educational program

Purpose of EP:

Training highly qualified technical specialists of top-level mining enterprises in digital modeling of mining and geomechanical processes at the intersection of geotechnology and geomechanics to solve scientific, technological, economic, social and environmental problems of mining, endowed with the skills of transition to a green economy, transformation of business planning processes and designing mining operations using mining and geological information systems and increasing the efficiency of mining companies through the redistribution of income within the value chain. The set of disciplines corresponds to the goals of sustainable development: quality education; decent work and economic growth; industrialization, innovation and infrastructure.

Tasks of EP:

- training of doctors by profile, competitive both domestically and on the international labour market, integration of national doctoral programmes into the global educational space;
- control, analyse and evaluate the actions of subordinates, manage a team of performers, including in emergency situations;
- carry out work to improve production activities, develop projects and programmes for the development of the enterprise (subdivisions of the enterprise);
- analyse the processes of mining, mining and construction production and complexes of used equipment as management objects;
- plan and perform theoretical, experimental and laboratory research, process the results obtained using modern information technologies;
- carry out patent search, study scientific and technical information, domestic and foreign experience on the subject of research;
- develop models of processes and phenomena, assess the reliability of the constructed models using modern methods and means of information analysis;
- carry out technical and economic evaluation of deposits of solid minerals and underground construction objects, efficiency of technological equipment utilisation;
- justify the parameters of a mining enterprise;
- perform calculations of technological processes, productivity of technical means of complex mechanisation of works, throughput capacity of transport systems of mining enterprises, prepare schedules of work organisation and calendar plans of production development;
- justify design solutions to ensure industrial and environmental safety, economic efficiency of production facilities for operational exploration, mining and

processing of minerals, construction and operation of underground facilities;

- develop the necessary technical documentation as part of creative teams and independently;
- independently draw up projects and passports for mining and drilling and blasting operations;
- design enterprises for the extraction and processing of solid minerals, as well as the construction of underground facilities using modern information technologies.

3. Requirements for evaluating the educational program learning outcomes

Persons who have mastered the educational programme of doctoral studies and defended a doctoral dissertation, in case of a positive decision of the dissertation councils of HEI with special status or the Committee for Control in the Sphere of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan according to the results of the conducted expertise, are awarded the degree of Doctor of Philosophy (PhD) or doctor on the profile and are issued a state diploma with an appendix (transcript). Persons who have received the degree of Doctor of PhD, to deepen scientific knowledge, to solve scientific and applied problems on a specialised topic perform a postdoctoral programme or conduct scientific research under the guidance of a leading scientist selected by the university.

Trainees have direct access to the QED, syllabi, syllabuses, which are posted on the university website, and also have the opportunity to familiarise themselves with the presentations of academic disciplines posted on the university website and departments.

The cycle of basic disciplines is the foundation of professional education.

The purpose of the cycle of core disciplines is to provide in-depth theoretical knowledge and practical application of specialised engineering knowledge.

Requirements for key competences of doctoral graduates:

1) have an idea of:

- about the main stages of development and change of paradigms in the evolution of science;
- the subject, outlook and methodological specificity of natural (social, humanitarian, economic) sciences;
- scientific schools of the relevant branch of knowledge, their theoretical and practical developments;
- scientific concepts of world and Kazakhstani science in the relevant field;
- the mechanism of introduction of scientific developments in practical activity;
- norms of interaction in the scientific community;
- about pedagogical and scientific ethics of a scientist-researcher.

2) to know and understand:

- modern trends, directions and regularities of development of domestic

science in the conditions of globalisation and internationalisation;

- methodology of scientific cognition;
- achievements of world and Kazakhstani science in the relevant field;
- (realise and accept) social responsibility of science and education;
- perfectly foreign language to carry out scientific communication and international co-operation;

3) be able to:

- organise, plan and implement the process of scientific research;
- analyse, evaluate and compare different theoretical concepts in the field of research and draw conclusions;
- analyse and process information from various sources;
- conduct independent scientific research characterised by academic integrity, based on modern theories and methods of analysis;
- generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;
- select and effectively use modern research methodology;
- plan and predict their further professional development;

4) have the skills to:

- Critically analyse, evaluate and compare different scientific theories and ideas;
- analytical and experimental scientific activity;
- planning and forecasting of research results;
- public speaking and public presentation at international scientific forums, conferences and seminars;
- scientific writing and scientific communication;
- planning, coordinating and implementing research processes;
- a systematic understanding of the field of study and demonstrate the quality and impact of selected scientific methods;
- systematic understanding of the field of study and demonstrate the quality and efficiency of the chosen scientific methods;
- participation in scientific events, fundamental scientific domestic and international projects;
- leadership management and team management;
- responsible and creative attitude to scientific and scientific-pedagogical activities;
- conducting patent searches and experience in communicating scientific information using modern information and innovation technologies;
- protection of intellectual property rights for scientific discoveries and developments;
- free communication in a foreign language;

5) to be competent:

- in the field of scientific and scientific-pedagogical activity in the conditions of rapid updating and growth of information flows;
- in conducting theoretical and experimental scientific research;
- in setting and solving theoretical and applied problems in scientific research;

- professional and comprehensive analysis of problems in the relevant field;
- interpersonal communication and human resource management;
- in matters of university training of specialists;
- Expertise of scientific projects and research;
- ensuring continuous professional development.

Requirements for the NIRD of a student on the Doctor of Philosophy (PhD) programme:

1) correspondence to the main problem of the educational programme of doctoral studies, on which the doctoral dissertation is defended;

2) is topical and contains scientific novelty and practical significance;

3) is based on modern theoretical, methodological and technological achievements of science and practice;

4) is based on modern methods of data processing and interpretation with the use of computer technologies;

5) is carried out using modern methods of scientific research;

6) contains research (methodological, practical) sections on the main defended provisions.

The practice is carried out with the purpose of formation of practical skills of scientific, scientific-pedagogical and professional activity.

The educational programme of doctoral studies includes:

1) pedagogical and research practice - for those studying on the programme of Doctor of Philosophy;

2) industrial practice - for students on the programme of profile doctoral studies.

During the period of pedagogical practice doctoral students, if necessary, are involved in conducting classes in bachelor's and master's programmes.

Research practice of doctoral students is carried out in order to study the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as to strengthen practical skills, application of modern methods of scientific research, processing and interpretation of experimental data in the dissertation research.

Production practice of doctoral students is carried out in order to consolidate the theoretical knowledge obtained in the process of training and to improve professional level.

The content of research and industrial practice is determined by the topic of the doctoral dissertation.

The students follow the programme of practice, keep diaries, observe the rules of labour regulations at the places of practice, study and observe the rules of safety. At the end of the internship provide the internship supervisor with a report on the internship, a written diary and defend the internship report in due time.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	8D07 – Engineering, manufacturing and construction industries
2	Code and classification of training directions	8D072 – Manufacturing and processing industries
3	Educational program group	D116 – Mining and mineral extraction
4	Educational program name	8D07211- Digital modelling of mining and geomechanical processes
5	Short description of educational program	Training implies serious research work, the fulfilment of which significantly increases the status of the doctoral student as a young scientist in his/her field of study
6	Purpose of EP	Training highly qualified technical specialists of top-level mining enterprises in digital modeling of mining and geomechanical processes at the intersection of geotechnology and geomechanics to solve scientific, technological, economic, social and environmental problems of mining, endowed with the skills of transition to a green economy, transformation of business planning processes and designing mining operations using mining and geological information systems and increasing the efficiency of mining companies through the redistribution of income within the value chain. The set of disciplines corresponds to the goals of sustainable development: quality education; decent work and economic growth; industrialization, innovation and infrastructure.
7	Type of EP	New
8	The level based on NQF	8
9	The level based on IQF	8
10	Distinctive features of EP	no
11	List of competencies of educational program	1) Apply a methodology for creating mining development plans, predictive models of the state of mining outcrops in the subsoil, redistribution of income within the value chain of vertically integrated mining companies in conditions of uncertainty of initial data. 2) Analyze scientific and technical information, domestic and foreign experience on research topics. 3) Carry out theoretical, experimental, field and laboratory research with processing of the results obtained using modern information technologies. 4) Use licensed software products to create working drawings and assess the stress-strain state of mining outcrops using generalized and sectoral geomechanical models, taking into account geological disturbances and tectonic faults in the subsurface. 5) Evaluate design solutions to ensure industrial and environmental safety, economic efficiency of mining solid minerals.

		6) Develop models of processes, phenomena and evaluate the reliability of the constructed models using modern methods and means of information analysis.
12	Learning outcomes of educational program	Defence of a doctoral thesis by a doctoral student after completion of studies in the profile doctoral programme 8D07211- «Digital Modelling of Mining and Geomechanical Processes».
13	Education form	Full-time
14	Period of training	3 years
15	Amount of credits	180
16	Languages of instruction	Kazakh, Russian, English
17	Academic degree awarded	Doctor in the profile of the educational program 8D07211- "Digital modeling of mining and geomechanical processes"
18	Developer and authors	Moldabaev S.K.

4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)					
				LO1	LO2	LO3	LO4	LO5	LO6
Cycle of general education disciplines									
1	Academic writing	Objective: to develop academic writing skills and writing strategies for doctoral students in engineering and natural sciences. Content: fundamentals and general principles of academic writing, including: writing effective sentences and paragraphs, writing an abstract, introduction, conclusion, discussion, and references; in-text citation; preventing plagiarism; and preparing a conference presentation.	5		X				
2	Methods of scientific research	Purpose: It consists in mastering knowledge about the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometry. Contents: structure of technical sciences, application of general scientific, philosophical and special methods of scientific research, principles of organization of scientific research, methodological features of modern science, ways of development of science and scientific research, the role of technical sciences, computer science and engineering research in theory and practice.	5			X			
Required component									
3	Environmentally friendly technologies in open-pit mining	Purpose: familiarization with best practices and international experience in the context of implementing green technologies in open-pit mining. Content: solving the transport problem of deep quarries in conjunction with reducing the separation of their sides and reducing emissions into the environment; ensuring minimum sizes of concentration horizons during the transition to combined modes of transport; maintaining high production capacity of quarries to great depths using innovative designs of steeply inclined lifts.	5	X	X			X	X
4	Establishing the spatial position of quarry contours in the dynamics of mining development	Purpose: establishing the optimal positions of the current and final contours of deep quarries based on digital models of deposits. Content: preparation of a three-dimensional geological model of the field; justification of the parameters that determine the optimal volumetric placement of the current and final contours of the quarry, the methodology for calculating their parameters; a method for establishing the volumetric current and final contours of a quarry on a new methodological basis; establishing the phased contours of the quarry under study based on a new method for optimizing the current and final contours of the quarry.	5	X	X		X	X	X
5	Level of balanced development of vertically integrated mining companies	Purpose: reveal aspects of increasing the efficiency of mining companies within the framework of vertical integration through the redistribution of income within the value chain. Content: sectoral and microeconomic support for the balanced use of strategic advantages of business segments of vertically integrated mining companies (VIGDC); determining the level of balanced development of the	5	X					X

		company's strategic advantages; the essence of the methodology for determining the index of balanced development of VIGDK and the feasibility of its use for an integral assessment of the program for increasing the efficiency of VIGDK and its business segments.							
6	Sustainability Science	Objective: to develop a deep understanding among doctoral students of the interactions between natural and social systems, as well as to develop skills for identifying and developing strategies for sustainable development that promote long-term human well-being and environmental preservation. Content: complex interconnections between ecosystems and societies, as well as an in-depth analysis of sustainability issues at local, national, and international levels.	5			X			
Cycle of specialised disciplines M-2. Module of specialised training (elective component)									
7	Innovative technologies for underground development of thin ore deposits	Purpose: development of advanced technologies for underground mining of thin ore deposits in the zone of geological disturbances. Content: opening, preparation and basic processes of underground mining of deposits; modern technologies used in deep conditions; manifestations of rock pressure in dynamic form; assessment of the stressed state of the massif and determination of safe parameters for development systems in rock-prone rock masses of a number of known fields; innovative methods of underground development of thin ore deposits.	5					X	X
8	Probabilistic-statistical modelling of geomechanical processes	Purpose: study the methodology for creating predictive models of rock behavior under conditions of uncertainty in the initial data. Content: processing of statistical data on the state of a rock mass, planning an experiment, constructing probabilistic models of rock strength and destruction, introducing a stochastic component into strength criteria (Hawk-Brown, Coulomb-Mohr, Parchevsky-Shashenko), simulation modeling using the Monte Carlo method.	5	X	X	X	X		X
9	Development of information systems for planning and designing mining operations	Purpose: analysis of the use of integrated systems and complexes of geo- information orientation in mining. Content: analysis of the use of integrated systems and complexes of geo-information orientation in mining; strategic planning of open-pit mining; optimizing mining sequence, selecting cut-off grades, quantities of mining equipment required and capital expenditures to maximize project net present value or achieve corporate objectives.	5				X		X
10	Physico-chemical geotechnology	Purpose: to master the basic issues of the theory of physical-chemical geotechnology and presentation of physical-chemical methods of mineral extraction. Content: geological, hydrogeological and other factors determining the effectiveness of physical-chemical geotechnology methods, stripping, preparation and systems of field development, means of mineral extraction, the specifics of design of geotechnological enterprises, methods of calculating the parameters of extraction, as well as economics and environmental protection issues.	5			X		X	
11	Designing the combined development of mineral deposits	Purpose: mastering of design skills in the transition from open pit to underground mining of mineral deposits. Content: geomechanical justification of the limiting height of the open-underground level and the thickness of the remaining pillar	5					X	X

		between the open and underground workings, the technology of mining the open-underground level, ways of effective safe transition to the underground method with the construction of underground workings, selection and justification of underground mining technology in conjunction with open pit mining, establishing the impact of the size of the open pit on the underground method of stripping and safety of underground mining operations.							
12	Numerical modeling of spatiotemporal processes in rock mass	Purpose: study numerical methods for determining the stress-strain state of a rock mass and assessing the stability of rock outcrops. Content: three-dimensional stress state of the massif, deformation models of the environment, finite element method (FEM), implementation of FEM in the RS3 Rocscience program, modeling the stability of underground mine workings, modeling the stability of quarry sides, modeling the development of mining operations over time.	5	X			X		X

5 Curriculum of the educational program

NON-PROFIT JOINT STOCK COMPANY
"KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV"

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 06.03.2025 Minutes № 10

WORKING CURRICULUM

Academic year — **2025-2026 (Autumn, Spring)**

Group of educational programs — **D116 - "Mining engineering"**

Educational program — **8D07211 - "Digital modeling of mining and geomechanical processes"**

The awarded academic degree — **Doctor of Engineering (Industry)**

Form and duration of study — **full time (professional track) - 3 years**

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters						Prerequisites
									1 course		2 course		3 course		
									1 sem	2 sem	3 sem	4 sem	5 sem	6 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
CYCLE OF BASIC DISCIPLINES (BD)															
M-1. Module of basic training (university component)															
MET322	Methods of scientific research		BD, UC	5	150	30/0/15	105	E	5						
LNG305	Academic writing		BD, UC	5	150	0/0/45	105	E	5						
MIN327	Environmentally friendly technologies in open-pit mining	1	BD, CCH	5	150	30/0/15	105	E	5						
MIN328	Establishing the spatial position of quarry contours in the dynamics of mining development	1	BD, CCH	5	150	30/0/15	105	E	5						
MIN329	Level of balanced development of vertically integrated mining companies	1	BD, CCH	5	150	30/0/15	105	E	5						
MNG350	Sustainability Science	1	BD, CCH	5	150	30/0/15	105	E	5						
CYCLE OF PROFILE DISCIPLINES (PD)															
M-2. Module of professional activity (component of choice)															
MIN330	Innovative technologies for underground development of thin ore deposits	1	PD, CCH	5	150	30/0/15	105	E	5						
MIN325	Probabilistic-statistical modeling of geomechanical processes	1	PD, CCH	5	150	30/0/15	105	E	5						
MIN331	Development of information systems for planning and designing mining operations	1	PD, CCH	5	150	30/0/15	105	E	5						
MIN317	Physico-chemical geotechnology	2	PD, CCH	5	150	30/0/15	105	E	5						
MIN320	Designing the combined development of mineral deposits	2	PD, CCH	5	150	30/0/15	105	E	5						
MIN326	Numerical modeling of spatiotemporal processes in rock mass	2	PD, CCH	5	150	30/0/15	105	E	5						
M-3. Practice-oriented module															
AAP371	Industrial intership		PD, UC	20				R		20					
M-4. Experimental-research module															
AAP372	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	5				R	5						
AAP376	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	10				R		10					
AAP374	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	30				R			30				

AAP374	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	30				R				30			
AAP374	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	30				R					30		
AAP375	Experimental research work of doctoral student, including internships and doctoral dissertations		ERWDS	18				R						18	
M-5. Module of final attestation															
ECA325	Final examination (writing and defending a doctoral dissertation)		FA	12										12	
Total based on UNIVERSITY:									30	30	30	30	30	30	
									60		**60**		**60**		

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	10	5	15
PD	Cycle of profile disciplines	0	20	10	30
Total for theoretical training:		**0**	**30**	**15**	**45**
RWDS	Research Work of Doctoral Student				0
ERWDS	Experimental Research Work of Doctoral Student				123
FA	Final attestation				12
TOTAL:					**180**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

Decision of the Academic Council of the Institute. Minutes № 4 dated 12.12.2024

Number of credits for the entire period of study

Signed:

Governing Board member - Vice-Rector for Academic Affairs — Uskenbayeva R. K.

Approved:

Vice Provost on academic development — Kalpeyeva Z. Б.

Head of Department - Department of Educational Program Management and Academic-Methodological Work — Zhumagaliyeva A. S.

Director - Mining and Metallurgical Institute named after O.A. Baikonurov — Rysbekov K. .

Department Chair - Mining — Moldabayev S. .

Representative of the Academic Committee from Employers — Bauyrzhan O.

____Acknowledged_____